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WORK PLAN

PHASE I GROUND-WATER STUDY
SIEMENS NUCLEAR POWER CORPORATION
RICHLAND, WASHINGTON

PROJECT NO. WA183.03

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Prepared for

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INTRODUCTION

This work plan has been prepared by Geraghty & Miller, inc. for a Phase I Ground-Water Study (Phase I study) to be conducted at the Siemens Nuclear Power Corporation (SNP) fuels fabrication facility in Richland, Washington (Figure 1). The purpose of the work plan is to present a technical approach to accomplish the objectives associated with the characterization of ground-water quality at the SNP site. The study is consistent with the remedial investigation requirements of an independent action under the State of Washington Model Toxics Control Act (MTCA), which SNP is pursuing. The proposed well locations and construction are consistent with initial site characterization requirements of other environmental cleanup programs, such as the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liabilities Act (CERCLA).

The work plan consists of the following elements:

- A summary of **background** information concerning the site.

- A statement identifying the **objectives** of the Phase I study.

- A summary of the general **technical approach** that will be taken to accomplish those objectives.

- A discussion of specific **tasks** that will be undertaken as part of the technical approach. These tasks include monitoring well installation, ground-water monitoring, data interpretation and report preparation, and project management.

- A **schedule** for carrying out the various tasks of the Phase I study.

- A **sampling and analysis plan** identifying the protocols for field methods and the laboratory analytical requirements (Appendix A).

- A **quality assurance project plan** defining the methods that Geraghty & Miller will employ to ensure that defensible data are generated (Appendix B).

- A **health and safety plan** defining the procedures that will be followed to minimize accidents and risks associated with field activities and to facilitate obtaining medical assistance, if necessary (Appendix C).

BACKGROUND

SITE LOCATION AND SETTING

The SNP facility is located at 2101 Horn Rapids Road in Richland, Washington (Figure 1). The topography at the SNP site and surrounding area is relatively flat. The SNP property consists of approximately 320 acres, most of which is undeveloped. The active facility area, which is fenced, comprises approximately 42 acres of the property. The Phase I study focuses on the fenced facility and the area immediately to the north between the fenced facility and Horn Rapids Road.

The area surrounding the SNP property is relatively undeveloped. The Hanford Reservation lies to the north and east. Immediately to the north and east is the 1100-EM-1 operable unit, one of four Hanford areas on the Comprehensive Environmental

Response, Compensation, and Liabilities Act (CERCLA) National Priorities List (NPL). The Horn Rapids Landfill (HRL), one of the operable subunits of the 1100-EM-1 operable unit, lies directly north of SNP across Horn Rapids Road. The South Pit portion of the HRL lies northeast of the active portion of the SNP facility and south of Horn Rapids Road. Potato fields lie to the south and west of the SNP property.

SITE DESCRIPTION

The primary function of the SNP facility is the manufacture of nuclear fuel assemblies for boiling-water and pressurized-water reactors. From incorporation until 1973, SNP was known as the Jersey Nuclear Company. From 1973 to 1987, the company was known as the Exxon Nuclear Power Company; and from 1987 to 1991, Advanced Nuclear Fuels Corporation. In 1991, the company's name changed to the Siemens Nuclear Power Corporation. During all of those time periods, the facility has operated under a license from the U.S. Nuclear Regulatory Commission (NRC).

The active portion of the SNP site includes a UO_2 facility where UF_6 is converted to UO_2, an office complex, several warehouses and shops, an ammonia recovery facility, and five process wastewater lagoons (Figure 2). Pursuant to environmental regulation by the NRC, 26 ground-water monitoring wells were installed at the site between 1973 and 1990 to assess the impact of the wastewater lagoons on ground-water quality. One of the wells has been abandoned, and three others have not been in continuous use.

Most of the area surrounding the office, process, and storage buildings is paved. The areas adjacent to the lagoons are primarily covered with sand and gravel. The lagoons are located on the east side of the facility and are surrounded by berms of soil. Process wastewater is piped to the lagoons through underground pipes, which are currently being replaced with encased pipes.

HYDROGEOLOGY

The following description of the hydrogeology for the SNP facility was obtained from the Phase I Remedial Investigation (RI) Report for the Hanford Site 1100-EM-1 Operable Unit [U.S. Department of Energy (USDOE) 1990] and from a report prepared by J-U-B Engineers for Exxon Nuclear Company (Exxon 1982).

Regional Hydrogeology

The SNP facility is located within the Pasco Basin which is bounded on the north, south, and west by anticlinal ridges and on the east by a broad zone of gradually increasing bedrock elevation. Figure 3 presents a generalized stratigraphic column for the region. The basin is underlain by numerous basalt flows with interbedded sediments of the Columbia River Basalt Group. The basalts are overlain by unconsolidated alluvial sediments of the Ringold Formation, which in turn are overlain by glaciofluvial sediments of the Hanford Formation. Surficial eolian and fluvial sediments overlie the Hanford Formation.

The Ringold Formation contains interbedded gravels, sands, silts, and clays. Four fining-upward sequences of sediments have been identified in the Ringold Formation, each of which contains a basal gravel. The sedimentary sequences can be differentiated based upon the composition of the basal gravels in the units. The basal gravels in the lowest sequence in the Ringold Formation were derived from within the Pasco Basin and are basalt-rich. The basal gravels of the overlying sequences were derived from granitic and metamorphic sources outside the Pasco Basin and are generally basalt-poor.

The Hanford Formation consists of moderately to poorly sorted glaciofluvial sediments. The sediments were deposited during several episodes of catastrophic flooding resulting from glacial ice-dam failures in western Montana and northern Idaho. Within the Pasco Basin, the coarse-grained, main-channel facies of these flood deposits are informally referred to as the Pasco gravels. The Pasco gravels consist predominantly of basaltic gravels in a sand or silty-sand matrix.

Ground-water aquifers in the Pasco Basin occur in both the basalt bedrock and overlying sediments (Figure 3). Confined aquifers occur in the sedimentary interbeds within the Columbia River basalts. Recharge to the basalt interbed aquifers is primarily from precipitation to the exposed basalt ridges surrounding the basin. Ground-water flow and discharge in the aquifers in the basalts is believed to be primarily to the Columbia River. The basalt interbed aquifers appear to also discharge upwards into the overlying sedimentary aquifers. The hydraulic conductivities for the basalt interbed aquifers range from 10^{-10} centimeters per second (cm/s) to 10^{-3} cm/s, or 10^{-6} feet per day (ft/d) to 10 ft/d.

Confined to semiconfined aquifers occur in the lower portion of the Ringold Formation and result from interfingering of silt aquitards and more permeable lenses of sand and gravel. These aquifers appear to be laterally discontinuous and may merge with the overlying unconfined aquifer.

The uppermost unconfined aquifer in the Pasco Basin occurs in the upper Ringold Formation and the lower Hanford Formation. The aquifer is laterally extensive and highly transmissive. Recharge to the unconfined aquifer occurs primarily from runoff of precipitation to the ridges surrounding the basin. Local surface water bodies and discharge of the underlying confined aquifers also contribute to the recharge of the unconfined aquifer. Percolation of precipitation does not appear to contribute significantly to the aquifer recharge. Ground-water flow and discharge in the unconfined aquifer is primarily to the Columbia River. Hydraulic conductivities for the aquifer range from 10^{-3} cm/s to 1 cm/s (1 ft/d to 1,000 ft/d).

Site Hydrogeology

The hydrogeologic system underlying the SNP site appears to be consistent with the regional hydrogeologic system. The facility is underlain by the Pasco gravels of the Hanford Formation and sands and gravels of the Ringold Formation (Exxon 1982). The unconfined aquifer beneath the site occurs at a depth of approximately 10 feet to 15 feet below land surface (bls). A silt aquitard was encountered at depths of approximately 43 feet bls during the drilling of Well TW-16 at the northeastern portion of the SNP site (Exxon 1982). The aquitard was reported to be at least 17 feet thick. A similar aquitard was encountered during the drilling of Well MW-9 at the southwest corner of the HRL and is reported to be approximately 33 feet thick (USDOE 1990). The aquitard was reported to underlie the entire 1100-EM-1 Operable Unit and varies in thickness from approximately 4 feet to 33 feet. The lateral extent of this aquitard beneath the SNP site has not been defined.

Ground-water level measurements at the SNP facility in July and August 1991 indicate that the direction of ground-water flow in the unconfined aquifer is to the north-northeast (Figures 3 and 4). These results are consistent with past observations. The gradient of potential flow is approximately 0.0003 feet per foot.

Ground-water recharge to the unconfined aquifer at the SNP site is most likely from the Yakima River, which is located approximately 2.5 miles southwest of the SNP site (Freshley et al. 1989) and from vertical discharge from deeper basalt aquifers (USDOE 1988). Discharge from the unconfined aquifer is to the Columbia River.

GROUND-WATER QUALITY

Constituents of concern in ground water at the SNP site include trichloroethene (TCE), nitrate, ammonia, fluoride, and radionuclides (gross-alpha and gross-beta radiation). All of these constituents except TCE are contained in process lagoon wastes from the nuclear fuel fabrication process. The origin of the TCE, which has been detected in samples from 15 wells since 1987, is not clear since there is no process application. TCE was used to solvent-weld the seams of the liners for the pretreatment lagoons.

In 1982, a ground-water plume containing elevated concentrations of ammonia, nitrate, fluoride, and sulfate was identified near the northeastern corner of the SNP facility (Exxon 1982). The plume was projected to be migrating in a northeasterly direction, towards the HRL.

In 1990, the USDOE released a Phase I RI Report for the 1100-EM-1 Operable Unit of the Hanford Site. In the RI report, USDOE concluded that the SNP complex has "contributed significant levels of contamination to operable unit ground waters in the vicinity of the Horn Rapids Landfill" and that the "contaminants known to have emanated from this facility are nitrate, fluoride, sulfate, ammonia, and gross-alpha and gross-beta radiation" (USDOE, 1990). In addition, USDOE attributed the presence of TCE in ground-water samples from the HRL to an upgradient source.

Since 1989 SNP has reported to the Washington Department of Ecology leaks of process wastewater containing ammonia and fluoride. The leaks were located immediately north of Lagoon #1 (Figure 2). The leaks resulted in some soil contamination, and elevated concentrations of ammonia and fluoride have been detected in ground-water samples collected from monitoring wells located downgradient from the location of the leaks.

Ground-water quality data have been collected from 25 wells at the SNP site. Selected wells have been sampled on a quarterly basis and analyzed for nitrate, ammonium, fluoride, and gross-alpha and -beta radiation since 1973 to fulfill the various requirements of a State Waste Discharge Permit and NRC license No. SNM-1227. Samples have been collected on a weekly basis since March 1990 at Wells TW-9 and

TW-26 and analyzed for ammonium to assess the extent of ground-water contamination resulting from a spill of waste containing ammonium hydroxide in July 1989. In addition, four rounds of samples were collected from selected SNP wells between February 1990 and June 1991 in conjunction with quarterly sampling by the USDOE at the HRL site. These samples were analyzed for TCE, nitrate, and gross-alpha and -beta radiation.

A complete round of ground-water samples from the 25 existing wells was collected in August 1991 to clarify existing site conditions. The samples were analyzed for TCE, dichloroethene and vinyl chloride (breakdown products of TCE), nitrate, ammonia, fluoride, and gross-alpha and -beta radiation. Analytical results are provided in Table 1.

Note that some uncertainty exists due to well construction regarding whether these concentration values represent actual aquifer water quality. All wells except for TW-17 and TW-18 are constructed of carbon steel which, due to corrosion and the presence of iron oxides, may impact water-quality results. Wells TW-17 and TW-18 are constructed of PVC and are smaller (3-inch diameter) than the other wells (6-inch diameter). These factors in combination with the uncertainty regarding well depths, screened intervals, and other construction information suggest that the data presented in Table 1 should not be assumed to be absolutely accurate. The following sections briefly summarize the concentration and distribution of each constituent of concern at the SNP site in August 1991.

The August 1991 analytical results are consistent with historical ground-water quality data. With the exception of TCE, the highest concentrations of all constituents occur in samples from Wells TW-9 and TW-26, located north of Lagoon #1 (Figure 2). Concentrations of constituents above background levels also occur in wells adjacent to and downgradient of Wells TW-9 and TW-26 (background levels were inferred from water-quality data provided by the U.S. Geological Survey for the Yakima-Horn area).

Ground-water samples from wells upgradient of the SNP facility did not show constituent concentrations above background levels.

Trichloroethene

The distribution of TCE in August 1991 is shown in Figure 6. The highest concentrations were 36 parts per billion (ppb) in samples from Wells TW-17 and TW-18 near the South Pit. As noted above, Wells TW-17 and TW-18 are the only wells that are constructed of PVC. Samples from wells adjacent to and downgradient of all the lagoons showed concentrations ranging from 5 ppb to 27 ppb. Samples from all wells upgradient and cross-gradient from the lagoons showed concentrations near or below the detection limit of 1 ppb.

In general, the breakdown products of TCE (dichloroethene and vinyl chloride) were not detected. Only trace amounts of 1,1-dichloroethene were detected in four samples (Wells TW-1, TW-8, TW-14, and TW-15).

Nitrate

The distribution of nitrate in August 1991 is shown in Figure 7. The highest concentrations were 108 parts per million (ppm) and 71.1 ppm of nitrate as nitrogen (NO_3 as N) in samples from TW-26 and TW-9, respectively. Nitrate concentrations ranged from approximately 25 ppm to 50 ppm in samples from wells adjacent to and downgradient from Wells TW-9 and TW-26. Samples from the remaining wells showed concentrations near or below 10 ppm.

Ammonia

The distribution of ammonia in August 1991 is shown in Figure 8. The highest concentrations are reported in samples from Wells TW-9 and TW-26, at 191 ppm and

405 ppm ammonia as nitrogen (NH_3 as N), respectively. Ammonia concentrations were over 10 ppm in samples from wells adjacent to and downgradient from TW-9 and TW-26 and were near or below the detection limit of 0.050 ppm in samples from all other wells.

Fluoride

The distribution of fluoride in August 1991 is shown in Figure 9. The highest fluoride concentrations were 23.8 ppm and 35.6 ppm in samples from Wells TW-9 and TW-26, respectively. Fluoride concentrations over 5 ppm were reported in samples from wells adjacent to and downgradient of TW-9 and TW-26. Fluoride concentrations in samples from almost all other wells were less than 1 ppm.

Radionuclides

The analytical results for gross-alpha and -beta radiation for August 1991 are not yet available. Data collected from June 1987 to June 1991 are summarized below.

Samples from every well are analyzed quarterly for gross-alpha and -beta radiation. Gross-alpha concentration has ranged from less than 1 picocurie per liter (pCi/L) to 71 pCi/L. Gross-alpha concentrations are highest in samples from Wells TW-1, TW-2, TW-9, TW-14, and TW-15. A sample from TW-17 in June 1991 had a gross-alpha concentration of 65.4 pCi/L. Samples from all other wells were below 15 pCi/L.

Gross-beta concentration has varied from 1.19 pCi/L to 63.2 pCi/L. Concentrations are highest in samples from Wells TW-2, TW-9, TW-14, and TW-15. A sample from Well TW-17 in June 1991 had a concentration of 167 pCi/L. Results for all other samples indicate gross-beta concentrations of less than 15 pCi/L.

PHASE I GROUND-WATER STUDY

The Phase I study was developed on the basis of the previous discussions on the hydrogeology and ground-water quality at the site. The focus of the Phase I study is on the unconfined aquifer and water-quality constituents known to be present on-site. The following sections present the objectives, the technical approach, a discussion of the major tasks, and a schedule for the Phase I study.

OBJECTIVES

The objectives of the Phase I study are as follows:

1. **Initial characterization of the ground-water flow system in the unconfined aquifer.** This objective involves developing an understanding of ground-water flow direction and gradients, and temporal and spatial changes in the unconfined aquifer. From a scientific and regulatory standpoint, knowledge of the ground-water flow system is essential to being able to assess potential sources of contamination, identify scenarios for contaminant migration, and begin evaluation of the need and options for cleanup.

2. **Initial characterization of the distribution of contaminants in the unconfined aquifer.** Data regarding the areal distribution of contaminants in the unconfined aquifer are necessary to meet the site characterization requirements of potentially applicable environmental regulatory programs. In addition, these data can be used to assist in identifying sources of contamination and other factors that may influence current and future contaminant distribution and concentrations in ground water.

3. **Assess the relative contributions of SNP, the South Pit, and the Horn Rapids Landfill (HRL) to ground-water contamination at the HRL.** Data generated during the proposed Phase I study will facilitate the assessment of the potential contributions of the SNP site, the South Pit, and the HRL to ground-water contamination downgradient of the HRL. Ground-water elevations and ground-water quality at the north boundary of the SNP site will be compared to the data generated by the USDOE from wells downgradient of the HRL. The direction of ground-water flow and differences in ground-water quality between the two sites, along with other data, will allow a preliminary assessment of the potential contributions the contaminant plume.

   To meet this objective, it is essential to generate ground-water data that are directly comparable to data generated by USDOE. Data comparability will be accomplished using well construction methods, field protocols, and analytical methods that are consistent, as appropriate, with those used by USDOE.

4. **Generate defensible data.** It is essential that data generated during the Phase I study be representative of conditions at the site, have the scientific accuracy and precision necessary to make future decisions regarding migration pathways or cleanup options, and have the documentation necessary to establish validity.

5. **Meet regulatory requirements.** It is unclear at this time which regulatory programs may be applicable to the site. However, the Phase I study has been designed to develop data for use in the CERCLA evaluation of the Horn Rapids Landfill and to be consistent with the remedial investigation requirements for an independent action under the MTCA, specifically the requirements for initial site characterization, monitoring well construction,

and sampling and analysis. Subsequent phases can be designed to satisfy additional regulatory requirements associated with applicable programs.

TECHNICAL APPROACH

The following presents an overview of the general technical approach that will be taken to meet the objectives.

Phase I

The objectives of the initial phase of site characterization at the SNP facility will be accomplished using the following technical approach:

- Installation of 12 ground-water monitoring wells.

- Collection of soil samples during monitoring well installation to define lithology and stratigraphy and for limited chemical and physical analyses.

- Measurement of ground-water levels.

- Collection and analysis of ground-water samples.

- Interpretation of geologic, hydrologic, and water-quality data.

Subsequent Phases

Based upon the results of the initial site characterization, subsequent phases may be necessary to address the following:

- Compliance with applicable regulations that are identified during the course of the investigation.

- Further delineation of the subsurface distribution of contaminants and sources of contamination through installation of additional monitoring wells, possibly in several phases.

- Determination of aquifer parameter values critical to understanding the fate and transport of the contaminants in the subsurface through performance of an aquifer test. Aquifer testing will likely require installation of a pumping well.

The following sections summarize each component of the proposed Phase I study.

PHASE I TASKS

Task 1: Monitoring Well Installation

Currently, 25 wells exist on-site. However, because of uncertainties regarding their construction coupled with the fact that most of them are carbon steel, these wells will not be used where precise and accurate data are necessary. These existing wells will continue to be used for water-level measurements for this program and may be used for additional sampling.

Geraghty & Miller proposes to install twelve 2-inch diameter ground-water monitoring wells in this phase of the investigation. The monitoring wells will be used to provide ground-water level and water-quality data for delineation of ground-water flow patterns and constituent distributions. One of the boreholes for the monitoring wells will be drilled down to the aquitard to identify its depth on site. The following summarizes pertinent information regarding these monitoring wells.

Monitoring Well Locations

The existing and proposed ground-water monitoring well locations are shown in Figure 2. The proposed monitoring well locations are approximate. Final locations will be selected after the evaluation of factors such as the locations of underground utilities and pipes, the locations of buildings, access requirements for drill rigs, SNP's daily operational needs, and the comments of regulatory officials.

The proposed well locations have been selected to support the previously stated objectives and upon the basis of Geraghty & Miller's present understanding of ground-water flow direction and contaminant distribution at the site. The direction of ground-water flow at the site is to the north-northeast, which is consistent with past observations. The distributions of nitrate, ammonia, and fluoride are highest north of Lagoon #1, and elevated concentrations are observed in wells adjacent to and downgradient of this area. TCE has been detected in samples from all wells adjacent to and downgradient of the lagoons. Ground-water quality data for samples from wells upgradient and cross-gradient from the lagoons do not indicate ground-water contamination in these areas.

Prior to monitoring well installation, one soil boring will be drilled at the location of proposed Well GM-2, upgradient of the SNP facility (Figure 2). The stratigraphic information from the boring will be correlated with the information from Well MW-9 at the HRL, downgradient of the SNP facility, to define the stratigraphy beneath the site. The boring will be drilled to a depth of 5 feet below the top of the silt aquitard (i.e., drilling will continue until the presence of the silt aquitard is confirmed). The silt aquitard reportedly exists at a depth of approximately 40 feet to 50 feet bls (Exxon 1982). This information will be used to determine the thickness of the unconfined aquifer at the site and to determine the depth to which the wells will be drilled.

All proposed monitoring wells will be completed within the upper part of the unconfined aquifer. The actual depth will be determined by the depth of the water table and the depth of the silt aquitard. The rationale for each of the proposed monitoring well locations is summarized below.

- Wells GM-1 and GM-2 are located in the apparent upgradient direction from the active portion of the SNP property (active site). These monitoring wells will provide data indicative of background water quality relative to the active site. Well GM-2 will be installed in the soil boring described above after backfilling the boring to the appropriate depth with bentonite.

- Wells GM-3 and GM-4 are located west of the area of identified contamination (plume) and will provide data for establishing the plume boundaries. Additional monitoring wells may be necessary to establish the western plume boundary if contaminants are detected in these monitoring wells.

- Wells GM-5, GM-6, GM-7, and GM-8 will provide data indicative of water quality downgradient of the active site and upgradient of the South Pit (although the areal extent of the South Pit is unclear). Well GM-6 will also aid in delineation of the eastern plume boundary.

- Wells GM-9, GM-10, GM-11, and GM-12 will provide data indicative of water quality leaving the SNP property. Differences in water quality between these monitoring wells and USDOE monitoring wells will aid in determining the relative contribution of the HRL to the contaminant plume detected in USDOE downgradient monitoring wells.

- Wells GM-11 and GM-12 are located between the South Pit and the HRL. A comparison of data from these monitoring wells with data from upgradient Wells GM-6, GM-7, and GM-8 will aid in determining the relative contribution of the South Pit to the contaminant plume.

Drilling Methodology

The monitoring wells will be drilled using either hollow-stem auger or Odex™ drilling methods. The drilling will first be attempted using the hollow-stem method. This drilling method is more cost-effective and allows for more accurate geologic logging than the Odex™ method. If the drilling cannot be accomplished using the hollow-stem auger because of the subsurface gravels, the drilling will be conducted using the Odex™ method.

The cable-tool drilling method is a viable alternative for drilling at the SNP facility; however, the proposed drilling methods allow more rapid progress, resulting in more cost-effective installations. The hollow-stem auger and Odex™ drilling methods provide drilling of comparable or higher quality than the cable-tool method.

- Hollow-stem auger drilling uses continuous-flight augers that are hollow in the center. A soil sampler or well construction materials can pass through the hollow center of the flights. A retractable plug is placed in the cutter head to prevent soil cuttings from entering the auger flights during drilling. The augers serve as temporary casing preventing caving or sloughing of the borehole wall during well installation. Soil samples are collected with a drive sampler and can be obtained at any depth.

- The Odex™ method uses a drill pipe to rotate a pilot bit and an eccentric reamer to advance the borehole. Temporary casing is installed in the reamed borehole as drilling progresses. The drill cuttings are forced up the drill pipe using compressed air and are diverted to 55-gallon drums. Soil samples are collected during drilling with a wire-line sampler and can be obtained at any depth. The temporary casing is removed during the monitoring well construction process.

Both of the drilling methods described above provide fast and efficient means of installing small-diameter monitoring wells; however, the hollow-stem auger method is generally more cost-effective. A disadvantage of the hollow-stem auger method is that it is generally not effective in soils with cobbles or boulders, which hamper the drilling effort. The drilling will first be attempted using the hollow-stem auger method. If this method is unsuccessful, the drilling will switch to the Odex™ method. The Odex™ system can be transported to the site and installed on the same drill rig used for auger drilling.

Soil samples will be collected with a wire-line or drive sampler during drilling for chemical and physical analyses. Samples will be collected at 5-foot intervals and at every change in lithology unless cobbles preclude drive sampling. Geologic logging will be performed by a geologist using methods consistent with EII 9.1, *Geologic Logging* (WHC 1988).

One soil sample from each borehole will be submitted to a geotechnical laboratory for grain-size analysis. This sample will be collected from a depth which corresponds to the screened interval for the well. The results will be used to estimate aquifer characteristics.

A limited number of samples will be collected and analyzed for TCE. These samples will be collected from boreholes in areas where TCE has been detected in ground water from a depth just above the apparent depth of the water table. Analytical results will be used to assess the distribution of TCE in the soil. A limited number of soil samples will also be collected from boreholes in areas of known ammonium hydroxide spills and analyzed for ammonia and nitrate.

If disturbed soil is encountered during drilling, i.e., if the borehole is located within the boundary of the South Pit, soil samples will be collected and analyzed by an analytical laboratory for Target Analyte List (TAL) and Target Compound List (TCL) parameters. The number and location of samples to be submitted to the laboratory will be determined in the field. Analytical results will be used to characterize the contents of the South Pit. All soil cuttings will be retained in barrels pending receipt of analytical results.

A detailed description of the soil sampling and analysis procedures is included in the Sampling and Analysis Plan (SAP) (Appendix A).

Monitoring Well Installation Methodology

The proposed monitoring well materials and design are consistent with USDOE protocol. A consistent approach will promote comparability of USDOE data with data generated during this investigation. Figure 10 shows the proposed monitoring well construction details. A description of the installation methodology follows. The description assumes that the boreholes will be drilled using hollow-stem augers. The installation procedure will be similar if the Odex™ method is used.

Each borehole will be drilled as specified in the previous section. After reaching the total depth, the stainless-steel screen and PVC casing for each monitoring well will be installed through the hollow-stem augers. The filter pack material and bentonite plug will be placed as the augers are withdrawn allowing these materials to fill the annular space between the well screen or casing and the borehole wall. The filter pack will extend approximately 3 feet above the top of the well screen. The bentonite plug will be placed above the filter pack and will be a minimum of 2 feet thick. Stainless-steel centralizers will be used if the Odex™ drilling method is used to keep the well screen centered in the borehole during the installation process. This measure is unnecessary with the hollow-stem auger method. The borehole will be sealed from the top of the bentonite plug to the surface with concrete. A locking steel protective casing which will extend above the ground surface will be embedded in the concrete. If necessary, some wells may be finished with covers that are flush with the ground surface.

Monitoring Well Construction Materials

Geraghty & Miller proposes to construct the monitoring wells using 2-inch diameter stainless-steel screen and 2-inch diameter PVC casing (Figure 10). The selection of stainless-steel well screens was based on the following criteria: (1) state regulations require use of either PVC or stainless-steel (Chapter 173-160 Washington Administrative Code); and (2) the USDOE monitoring wells were constructed with stainless-steel casing and screen, and similar construction of the proposed monitoring wells will promote data comparability. The PVC casing will extend from the top of the well screen, which will be located above the seasonal high ground-water level, to the ground surface.

Monitoring Well Completion

All monitoring well completions will be consistent with EII 6.8, *Well Completion* (WHC 1988). The top-of-casing elevation of each monitoring well will be surveyed to the nearest 0.01 feet, relative to the established datum used by USDOE. Horizontal locations will be surveyed to the nearest foot.

Monitoring Well Development

Each monitoring well will be developed following completion and prior to ground-water sampling. Monitoring well development methodologies will be consistent with EII 10.4, *Well Development Activities* (WHC 1988). Development water will be retained in barrels pending ground-water analytical results.

<u>**Task 2: Ground-Water Monitoring**</u>

Monthly water-level measurements and quarterly ground-water monitoring data will be collected for 1 year after the installation of the monitoring wells. Water-level data will be used to characterize the ground-water flow system, and analytical results will be used to characterize the distribution of contaminants in the ground-water at the site. Measurement, sampling, and analytical methods will be consistent with those used by USDOE to ensure the comparability of the data sets. A detailed description of the ground-water sampling and analysis procedures is provided in the SAP (Appendix A).

Subtask 2.1: Water-level Measurements

Water levels in all existing and proposed wells will be measured on a monthly basis in coordination with USDOE's current schedule for water-level measurement at the HRL. Coordination will allow the generation of a composite data set that will provide ground-water flow information for a larger area. This information is essential in evaluating contaminant migration. Methods used to measure water levels are described in the SAP (Appendix A).

Subtask 2.2: Ground-Water Sampling and Analysis

Ground-water samples will be collected from the new monitoring wells 1 to 2 weeks after well installation is complete. Following initial sample collection, the wells will be sampled on a quarterly basis for 1 year. The frequency of sampling may be increased in some wells after review of initial analytical results. Quarterly sampling will be concurrent with quarterly sampling by USDOE at the HRL.

Ground-water samples will be analyzed for the constituents identified in Table A-3. Criteria used to select the analytes were based upon a review of existing ground-water-quality data from SNP and HRL, a review of the list of constituents from known releases, and the need for general water-quality information.

Procedures for conducting ground-water monitoring are outlined in the SAP (Appendix A). The SAP meets the requirements specified in the MTCA (Chapter 173-340-820 WAC). The methods that will be used to ensure that defensible data are generated during ground-water monitoring are outlined in the Quality Assurance Project Plan (Appendix B). Purge water generated during sampling will be retained in barrels pending analytical results.

Task 3: Data Interpretation and Report Preparation

As outlined in the Schedule section, this work plan will be implemented over a period of approximately 18 months. During that time, the following reports will be prepared:

Monitoring Well Construction Report. This report will document the installation and development of the proposed monitoring wells. Well construction diagrams and boring logs will be provided for each installation. The report will include an interpretation of the near-surface geology based on the lithologic logs from SNP and HRL wells.

Quarterly Ground-Water Monitoring Reports. Following receipt of the analytical results from each quarterly ground-water sampling event, a report will be prepared which documents the sampling event and summarizes the analytical data. Data for the current quarter will be compared with previous data and a limited interpretation of the data will be provided. Figures will be included in these reports which show the ground-water elevation contours and distribution of contaminants based on the data for the current quarter.

Phase I Ground-Water Study Report. Following the fourth quarterly sampling event, a report will be prepared which documents the field collection efforts, summarizes and interprets the data collected, and makes conclusions regarding the objectives. The data summarized will include lithologic data collected during monitoring well installation, soil and ground-water analytical data, data collected by USDOE and the HRL, and other relevant data. The report will provide an interpretation of these data sets which is consistent with the stated objectives.

Following is a brief overview of some of the methodologies that will be employed to obtain the technical objectives of the study.

1. **Initial characterization of the unconfined aquifer flow system.** Water-level elevation data for the SNP and HRL sites will be plotted for each month to determine variations in flow directions and gradients. Hydrographs of selected wells will be plotted to assess seasonal and other responses to ground-water recharge and discharge events. Sources of recharge (i.e., irrigation and Yakima River infiltration) and discharge points will be investigated further. The temperatures of ground water from wells will be plotted to assess flow systems and water sources. Ground water will be characterized by water type, and Stiff diagrams for the major-ion composition of water in each well and in the Columbia and Yakima Rivers will be developed.

2. **Initial characterization of the distribution of contaminants in the unconfined aquifer.** Key water-quality data will be plotted for each sample round to assess spatial patterns in the distribution of constituents. Trend plots for selected water-quality parameters for selected wells will be plotted to assess changes through time. These data will be compared with contaminant source data and other events potentially affecting water quality to assess cause-and-effect relationships.

3. **Assess the relative contributions of SNP, the South Pit, and the HRL to ground-water contamination at the HRL.** Water-level and water-quality data from both the SNP and HRL site will be used. Water-level elevation data will be used to assess contaminant migration pathways, and key water-quality data will be plotted for each sampling event to assess spatial patterns and potential source areas. Average major-ion concentrations (presented as Stiff diagrams) will be plotted to assess subsurface geochemical and microbiological processes, ground-water sources and flow paths, and contaminant sources. Statistical methods will be evaluated for applicability to the site and, if appropriate, will be employed. A simple ground-water model may be employed as a tool to assess past and future contaminant migration and/or to define areas for future data collection.

Task 4: Project Management

The Geraghty & Miller project manager will coordinate the scheduling of the field activities and provide technical review of the project tasks. The project manager will also manage the project administration and invoicing, provide fiscal responsibility and budget control, and provide ongoing communications with the SNP and the regulatory agencies, as appropriate.

SCHEDULE

Figure 11 presents a preliminary schedule for carrying out the Phase I study. The schedule includes the period from October 1991 to March 1993. The schedule anticipates a start date of mid-October 1991 for monitoring well installation, in which case the November 1991 USDOE sample round will be the start of the quarterly monitoring program for SNP. Should quarterly monitoring not start until February 1991, the end date is projected to be May 1993. This schedule assumes that no major delays in the implementation of tasks will occur.

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TABLES

TABLE 1. ANALYTICAL RESULTS FOR AUGUST 1991 GROUND-WATER SAMPLES
PHASE I GROUND-WATER STUDY WORK PLAN
SIEMENS NUCLEAR POWER CORPORATION, RICHLAND, WASHINGTON

WELL ID	SAMPLING DATE	AMMONIA AS N (mg/l)	NITRATE AS N (mg/l)	NITRITE AS N (mg/l)	FLUORIDE (mg/l)	GROSS ALPHA RADIATION (pCi/l)	GROSS BETA RADIATION (pCi/l)
TW-1	16-Aug-91	33.1	31.8	0.147 (3)	5.48	NA	NA
TW-2	16-Aug-91	12.3	25.1	0.094 (3)	5.40	NA	NA
TW-3	16-Aug-91	0.050 U	13.0	0.100 U	0.350	NA	NA
TW-4	16-Aug-91	0.050 U	11.5	0.100 U	0.338	NA	NA
TW-5	15-Aug-91	0.050 U	1.89	0.100 U	0.300	NA	NA
TW-6	14-Aug-91	0.050 U	3.95	0.100 U	0.331	NA	NA
TW-7	14-Aug-91	0.050 U	1.39	0.100 U	0.310	NA	NA
TW-8	14-Aug-91	0.065	6.20	0.100 U	0.391	NA	NA
TW-9	16-Aug-91	191	71.1	10.7	23.8	NA	NA
TW-11	15-Aug-91	0.050 U	9.83	0.100 U	0.412	NA	NA
TW-12	15-Aug-91	0.050 U	3.86	0.100 U	0.344	NA	NA
TW-13	15-Aug-91	0.050 U	7.00	0.100 U	0.280	NA	NA
TW-14	16-Aug-91	15.6	51.0	0.122 (3)	11.3	NA	NA
TW-15	16-Aug-91	43.7	35.7	0.026 (3)	10.2	NA	NA
TW-16	16-Aug-91	10.4	0.499	0.167 (3)	3.48	NA	NA
TW-17	16-Aug-91	0.434	9.82	0.100 U	0.595	NA	NA
TW-18	16-Aug-91	10.6	24.4	0.013 (3)	3.92	NA	NA
TW-19	15-Aug-91	0.050 U	4.96	0.100 U	0.228	NA	NA
TW-20	15-Aug-91	0.050 U	3.70	0.100 U	0.326	NA	NA
TW-21	15-Aug-91	0.050 U	3.60	0.100 U	0.331	NA	NA
TW-22	14-Aug-91	0.052	9.45	0.100 U	0.312	NA	NA
TW-23	13-Aug-91	0.052	2.78	0.100 U	0.280	NA	NA
TW-24	14-Aug-91	0.050 U	4.30	0.100 U	0.322	NA	NA
TW-25	14-Aug-91	0.050 U	10.9	0.100 U	0.468	NA	NA
TW-26	16-Aug-91	405	108	19.5	35.6	NA	NA
TW-27 (1)	16-Aug-91	739	110	18.9	37.4	NA	NA
TW-30 (2)	16-Aug-91	0.050 U	0.100 U	0.100 U	0.100 U	NA	NA

Analyses were conducted using the following methods: ammonia by 350.3, nitrate and nitrite by 300.0, fluoride by 340.2, gross alpha and gross beta radiation by 900.0.

mg/l	Milligrams per liter
pCi/l	Picocuries per liter
U	Constituent not detected at the given detection limit
J	Estimated value
NA	Not available
(1)	Duplicate sample of TW-26
(2)	Field blank
(3)	Nitrite by EPA Method 354.1

I:\SNPC\WA18303\AUGSAMP.WQ1

TABLE 1. ANALYTICAL RESULTS FOR AUGUST 1991 GROUND-WATER SAMPLES
PHASE I GROUND-WATER STUDY WORK PLAN
SIEMENS NUCLEAR POWER CORPORATION, RICHLAND, WASHINGTON

WELL ID	TCE (ug/l)	1,1-DCE (ug/l)	TRANS-1,2-DCE (ug/l)	VINYL CHLORIDE (ug/l)	PH (SU)	SPECIFIC CONDUCTANCE (umhos/cm)	TEMPERATURE (degrees C)
TW-1	11	0.7 J	1.0 U	1.0 U	6.7	790	19.3
TW-2	27	1.0 U	1.0 U	1.0 U	6.6	556	19.6
TW-3	12	1.0 U	1.0 U	1.0 U	6.7	414	18.2
TW-4	11	1.0 U	1.0 U	1.0 U	6.7	400	17.9
TW-5	9.6	1.0 U	1.0 U	1.0 U	7.1	289	18.2
TW-6	5.5	1.0 U	1.0 U	1.0 U	7.0	298	21.9
TW-7	5.5	1.0 U	1.0 U	1.0 U	7.2	265	22.7
TW-8	1.0 U	0.7 J	1.0 U	1.0 U	6.7	593	19.4
TW-9	11	1.0 U	1.0 U	1.0 U	9.6	1430	20.8
TW-11	10	1.0 U	1.0 U	1.0 U	6.7	387	19.5
TW-12	16	1.0 U	1.0 U	1.0 U	6.7	314	21.1
TW-13	1.0 U	1.0 U	1.0 U	1.0 U	6.7	400	19.4
TW-14	12	0.5 J	1.0 U	1.0 U	6.7	873	19.6
TW-15	25	0.6 J	1.0 U	1.0 U	6.9	840	19.3
TW-16	12	1.0 U	1.0 U	1.0 U	8.8	267	17.9
TW-17	36	1.0 U	1.0 U	1.0 U	6.7	468	19.5
TW-18	36	1.0 U	1.0 U	1.0 U	6.6	533	19.1
TW-19	7.9	1.0 U	1.0 U	1.0 U	7.3	446	19.6
TW-20	4.1	1.0 U	1.0 U	1.0 U	7.5	366	19.5
TW-21	1.6	1.0 U	1.0 U	1.0 U	7.7	371	19.4
TW-22	1.0 U	1.0 U	1.0 U	1.0 U	6.8	629	19.6
TW-23	1.0 U	1.0 U	1.0 U	1.0 U	6.7	388	NA
TW-24	1.0 U	1.0 U	1.0 U	1.0 U	7.1	347	19.0
TW-25	1.0 U	1.0 U	1.0 U	1.0 U	6.9	452	18.1
TW-26	12	1.0 U	1.0 U	1.0 U	10.2	1526	20.9
TW-27 (1)	13	1.0 U	1.0 U	1.0 U	NA	NA	NA
TW-30 (2)	1.0 U	1.0 U	1.0 U	1.0 U	NA	NA	NA

TCE; 1,1-DCE; trans-1,2-DCE; and vinyl chloride were analyzed by EPA Method 601; and pH, specific conductivity, and temperature were measured in the field.

TCE	Trichloroethene
DCE	Dichloroethene
ug/l	Micrograms per liter
SU	Standard units
umhos/cm	Micromhos per centimeter
C	Centigrade
U	Constituent not detected at the given detection limit
J	Estimated value
NA	Not available
(1)	Duplicate sample of TW-26
(2)	Equipment blank

FIGURES

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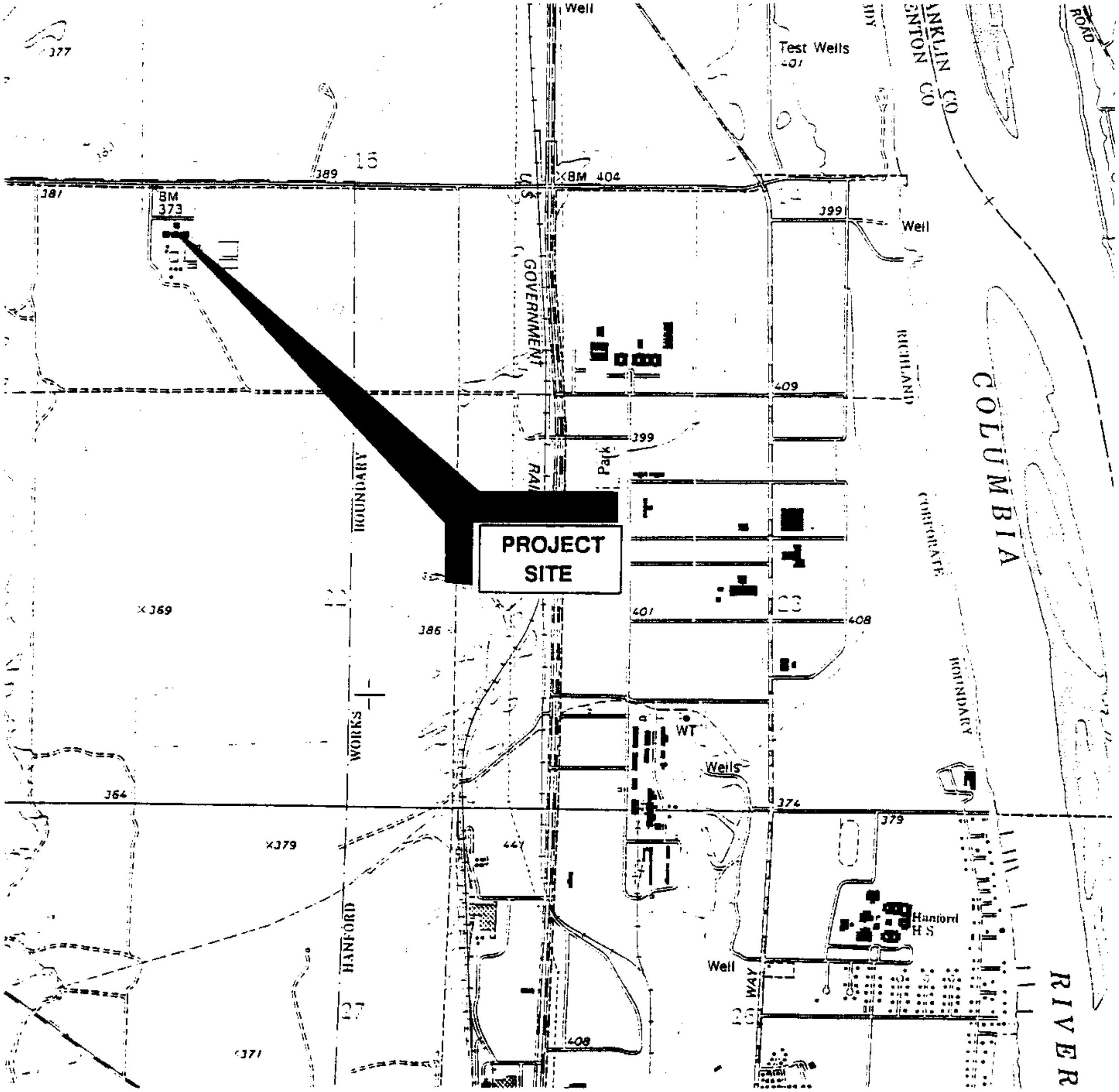
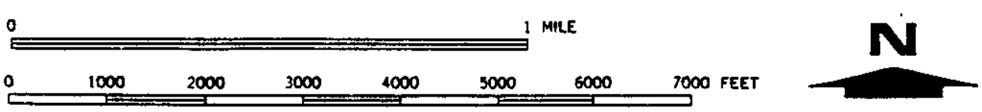
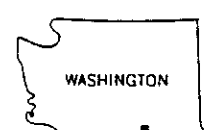


SOURCE: USGS 7.5 Minute Topographic Map, RICHLAND, WASHINGTON Quadrangle, 1978.





QUADRANGLE LOCATION

GERAGHTY & MILLER, INC.
Environmental Services

SITE LOCATION MAP

Siemens Nuclear Power Corporation
Richland, Washington

FIGURE **1**

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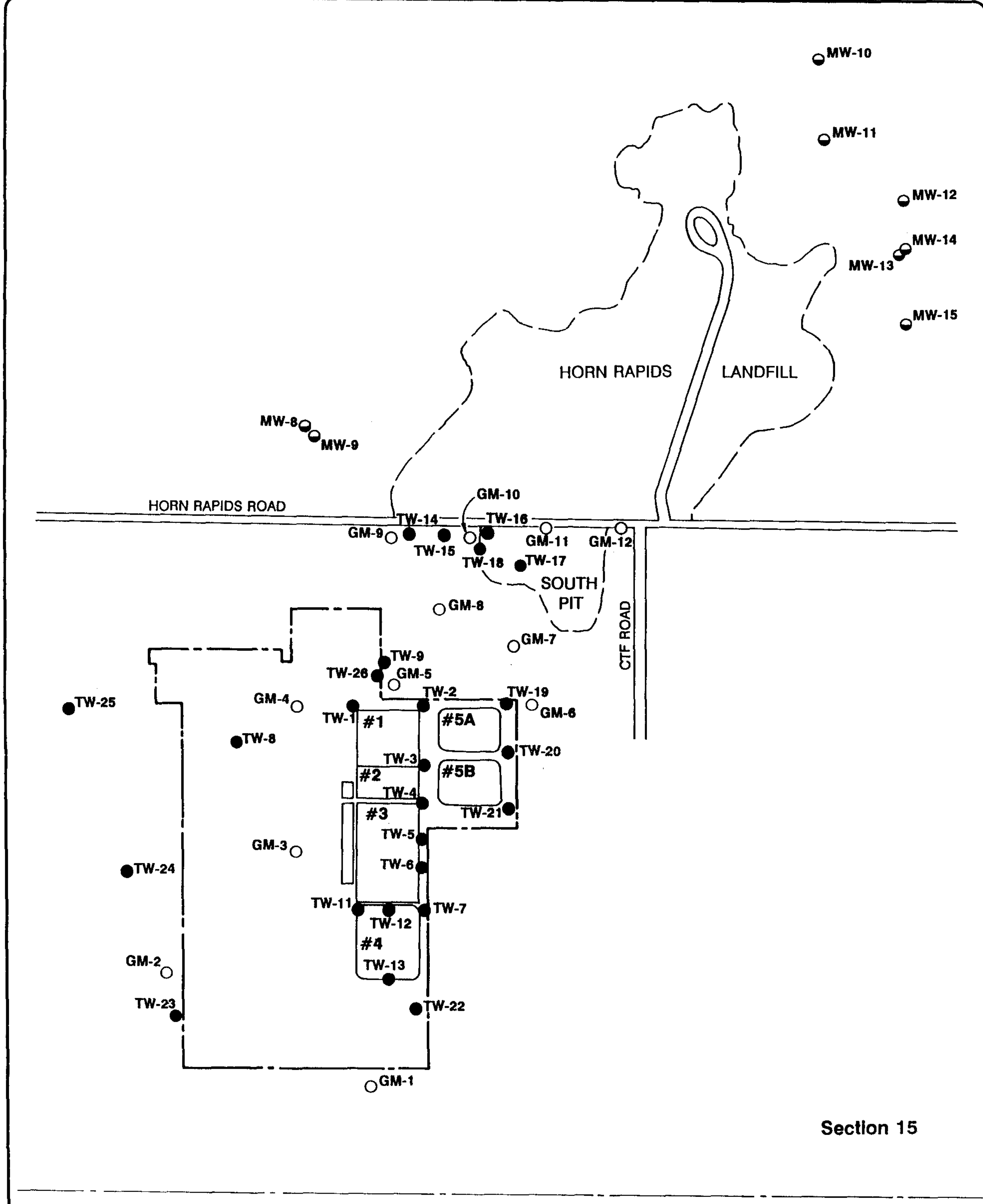
DWG DATE: JULY 1991 | PRJCT NO.: WA183.03 | FILE NO.: | DRAWING: | CHECKED: | APPROVED: PJW | DRAFTER: SAC



LEGEND

- Existing DOE Monitoring Well ("MW" Wells)
- Existing SNP Monitoring Well ("TW" Wells)
- Proposed SNP Monitoring Well ("GM" Wells)
- Approximate Landfill Boundary
- #1 Lagoon Designation

N

0 200 400 600
Approximate Scale in Feet

GERAGHTY & MILLER, INC.
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WELL LOCATION MAP

Siemens Nuclear Power Corporation
Richland, Washington

FIGURE
2

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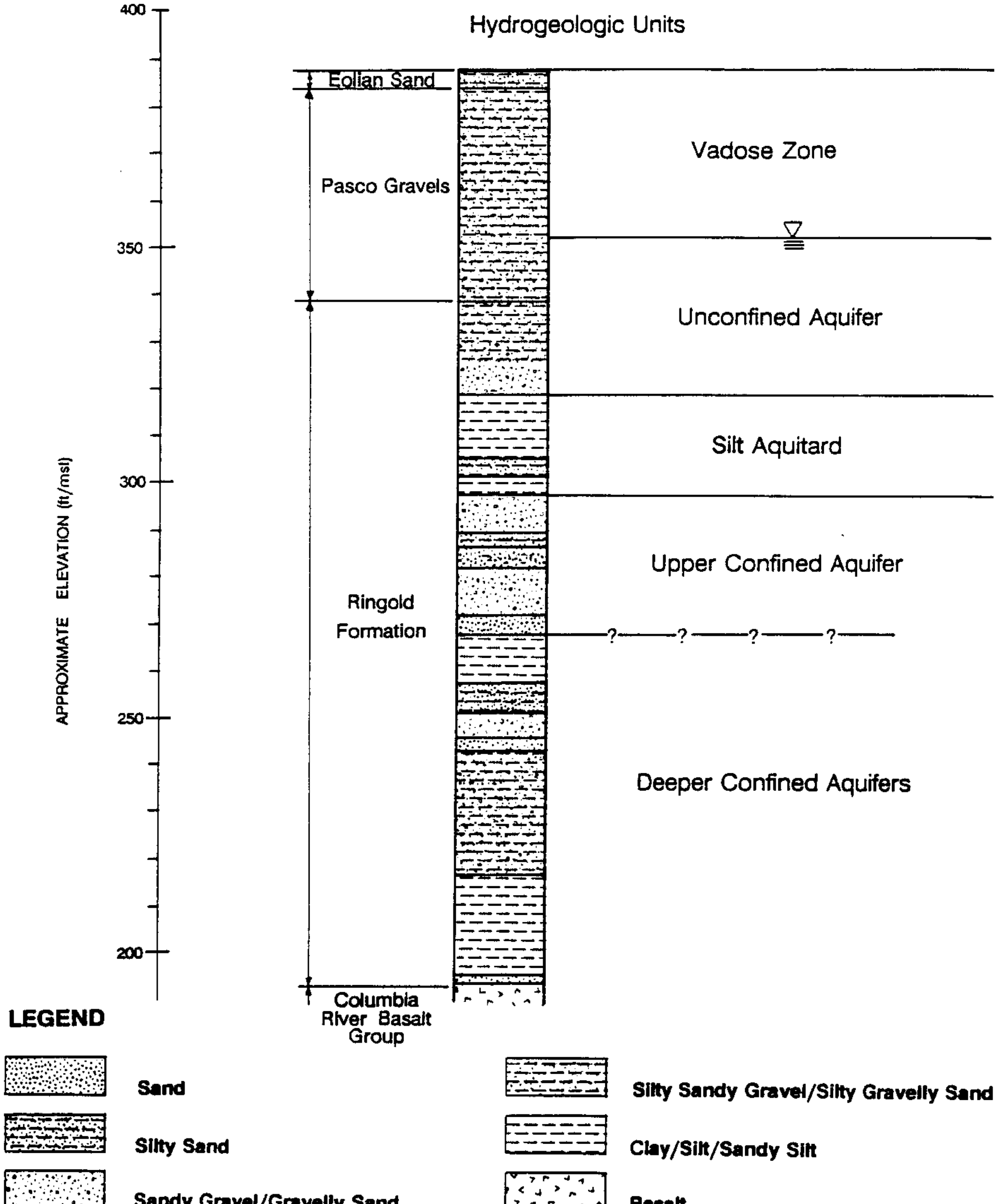


REFERENCE: DOE, 1990

DWG DATE: AUG 1991 | PRJCT NO.: WA183.03 | FILE NO.: | DRAWING: | CHECKED: | APPROVED: LER | DRAFTER: SAC

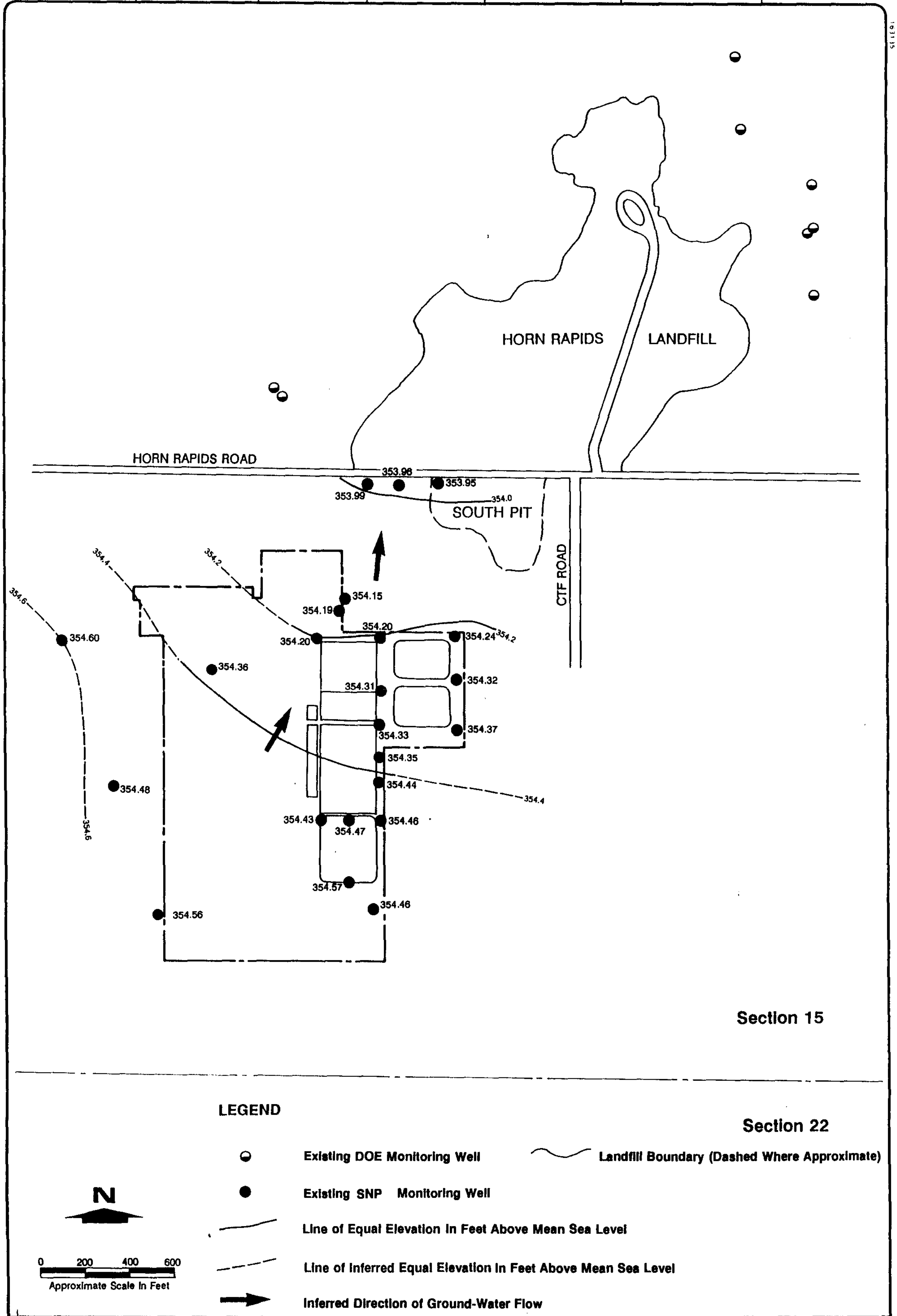
GERAGHTY & MILLER, INC.
Environmental Services

GENERALIZED HYDROSTRATIGRAPHIC COLUMN

Siemens Nuclear Power Corporation
Richland, Washington

FIGURE **3**

DWG DATE: JULY 1991 | PRJCT NO.: WA183.03 | FILE NO.: | DRAWING: | CHECKED: | APPROVED: PJW | DRAFTER: SAC



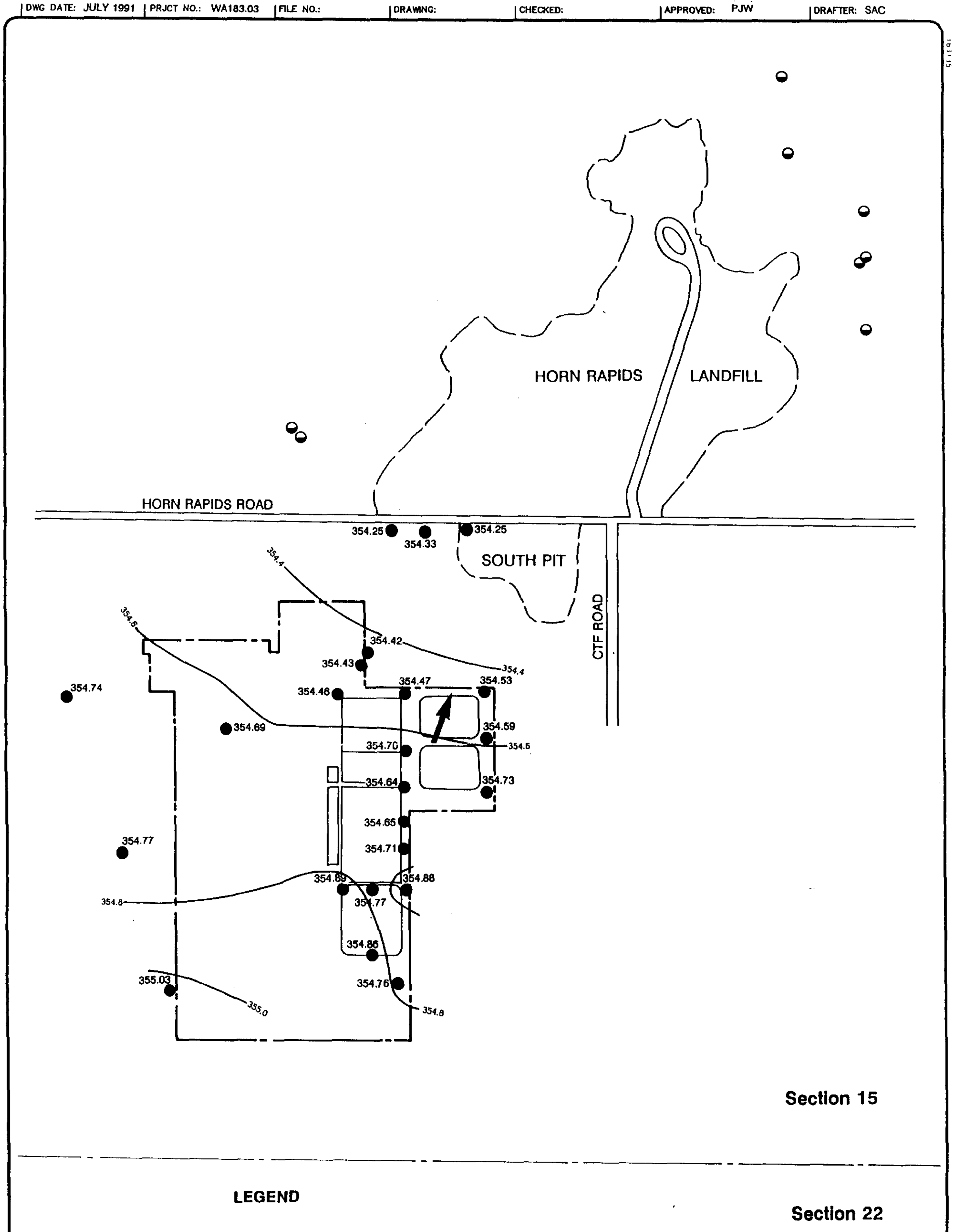
GERAGHTY & MILLER, INC.
Environmental Services

GROUND-WATER SURFACE ELEVATION CONTOURS JULY 1991

Siemens Nuclear Power Corporation
Richland, Washington

FIGURE
4

DWG DATE: JULY 1991 | PRJCT NO.: WA183.03 | FILE NO.: | DRAWING: | CHECKED: | APPROVED: PJW | DRAFTER: SAC



LEGEND

- Existing DOE Monitoring Well
- Existing SNP Monitoring Well
- Line of Equal Elevation In Feet Above Mean Sea Level
- Inferred Direction of Ground-Water Flow
- Approximate Landfill Boundary

N

0 200 400 600

Approximate Scale In Feet

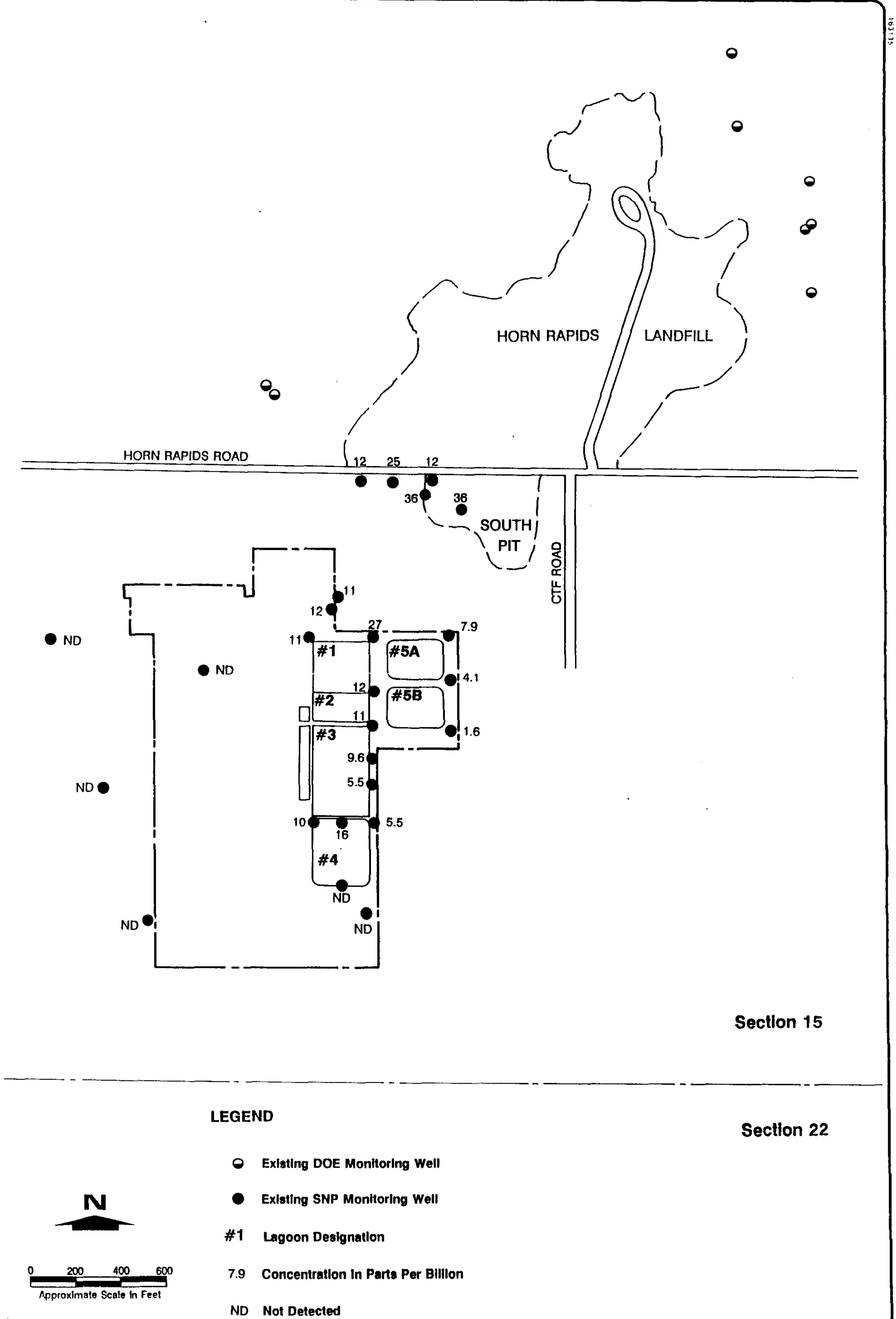
GERAGHTY & MILLER, INC.
Environmental Services

GROUND-WATER SURFACE ELEVATION CONTOURS, AUGUST 1991

Siemens Nuclear Power Corporation
Richland, Washington

FIGURE **5**

DWG DATE: JULY 1991 | PRJCT NO.: WA183.03 | FILE NO.: | DRAWING: | CHECKED: | APPROVED: PJW | DRAFTER: SAC



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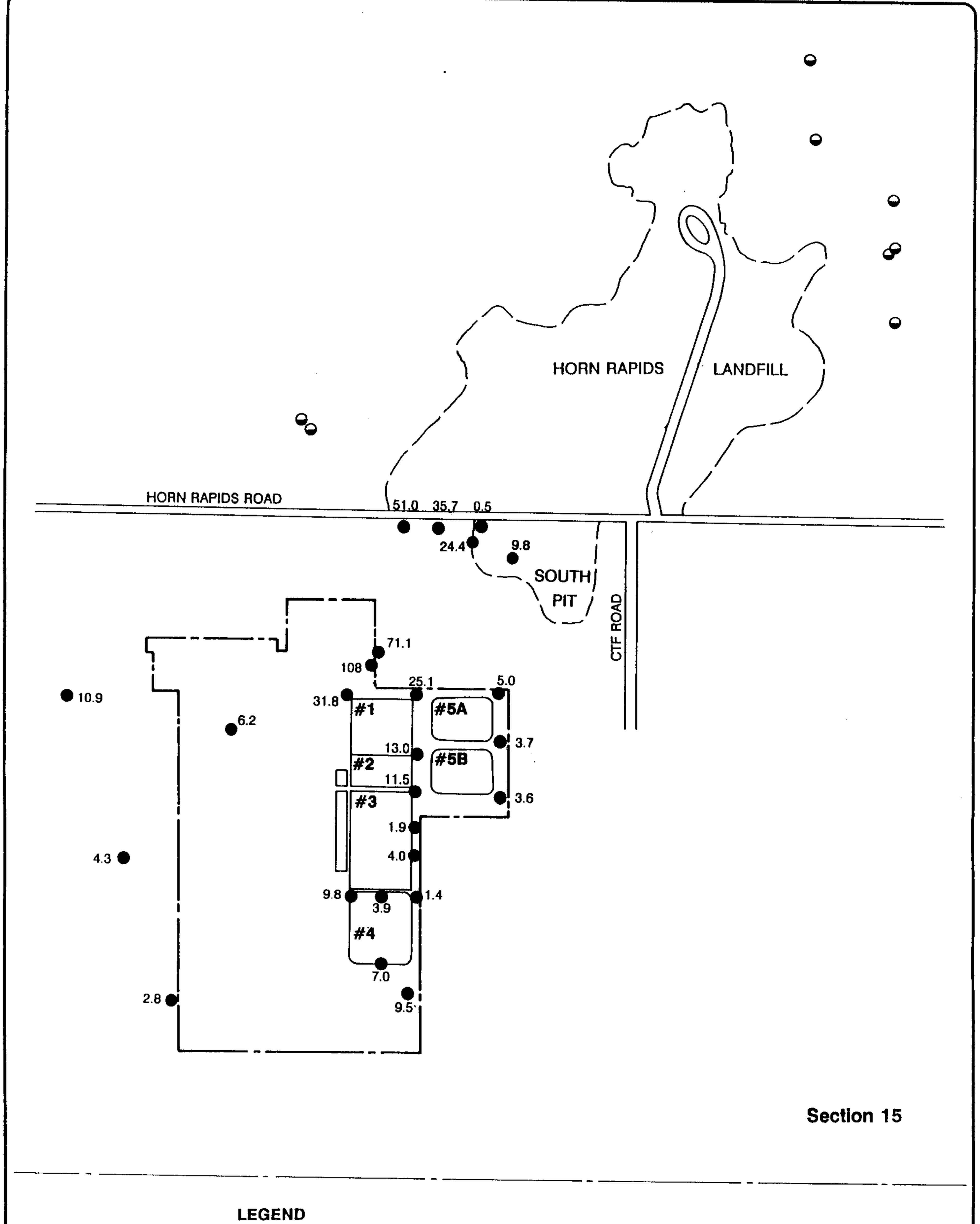
DISTRIBUTION OF TCE IN GROUND-WATER SAMPLES, AUGUST 1991

Siemens Nuclear Power Corporation
Richland, Washington

FIGURE 6

DWG DATE: JULY 1991 | PRJCT NO.: WA183.03 | FILE NO.: | DRAWING: | CHECKED: | APPROVED: PJW | DRAFTER: SAC



LEGEND

- Existing DOE Monitoring Well
- Existing SNP Monitoring Well
- #1 Lagoon Designation
- 5.0 Concentration in Parts Per Million

GERAGHTY & MILLER, INC.
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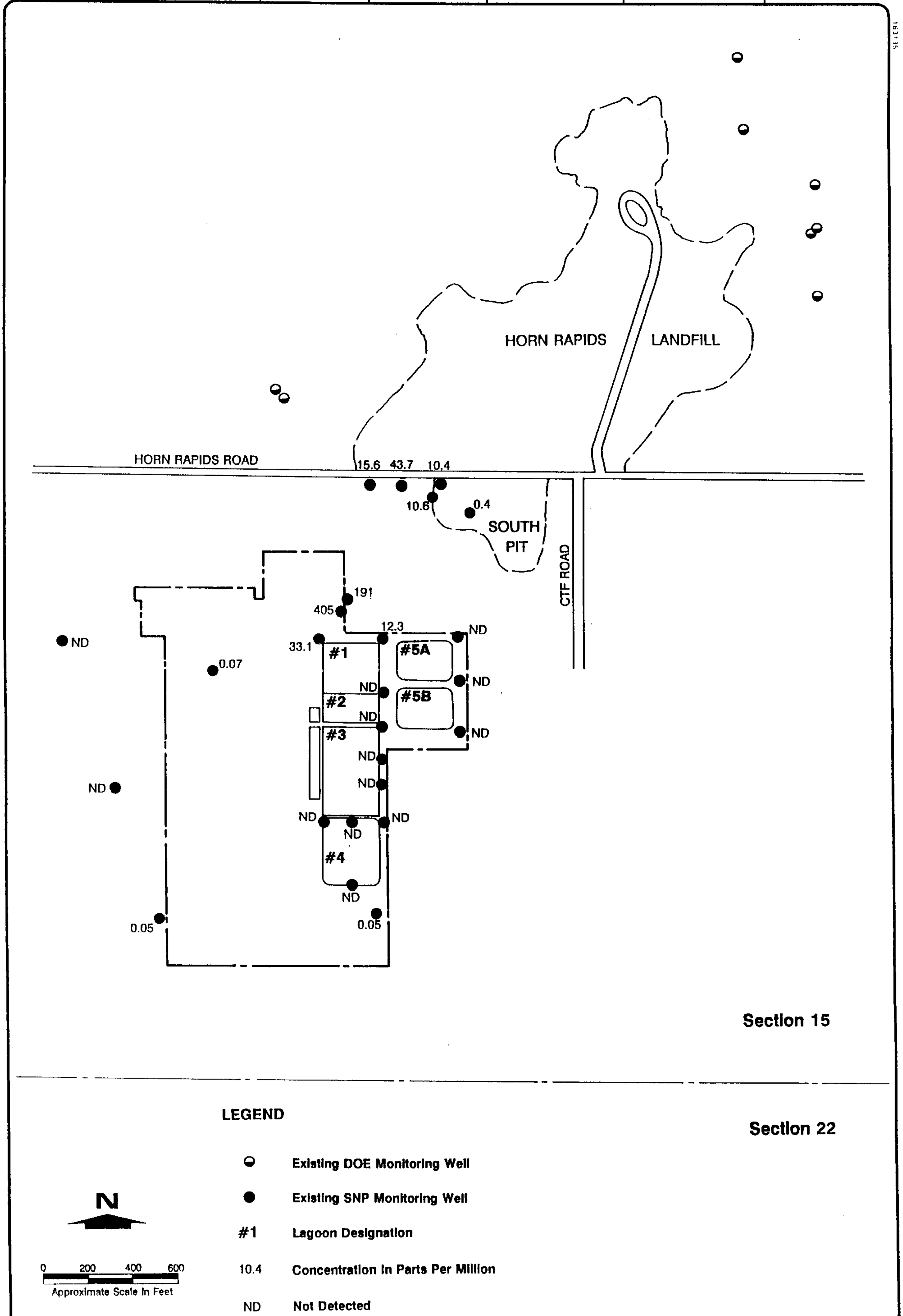
DISTRIBUTION OF NITRATE AS NITROGEN IN GROUND-WATER SAMPLES, AUGUST 1991

Siemens Nuclear Power Corporation
Richland, Washington

FIGURE 7

DWG DATE: JULY 1991 | PRJCT NO.: WA183.03 | FILE NO.: | DRAWING: | CHECKED: | APPROVED: PJW | DRAFTER: SAC



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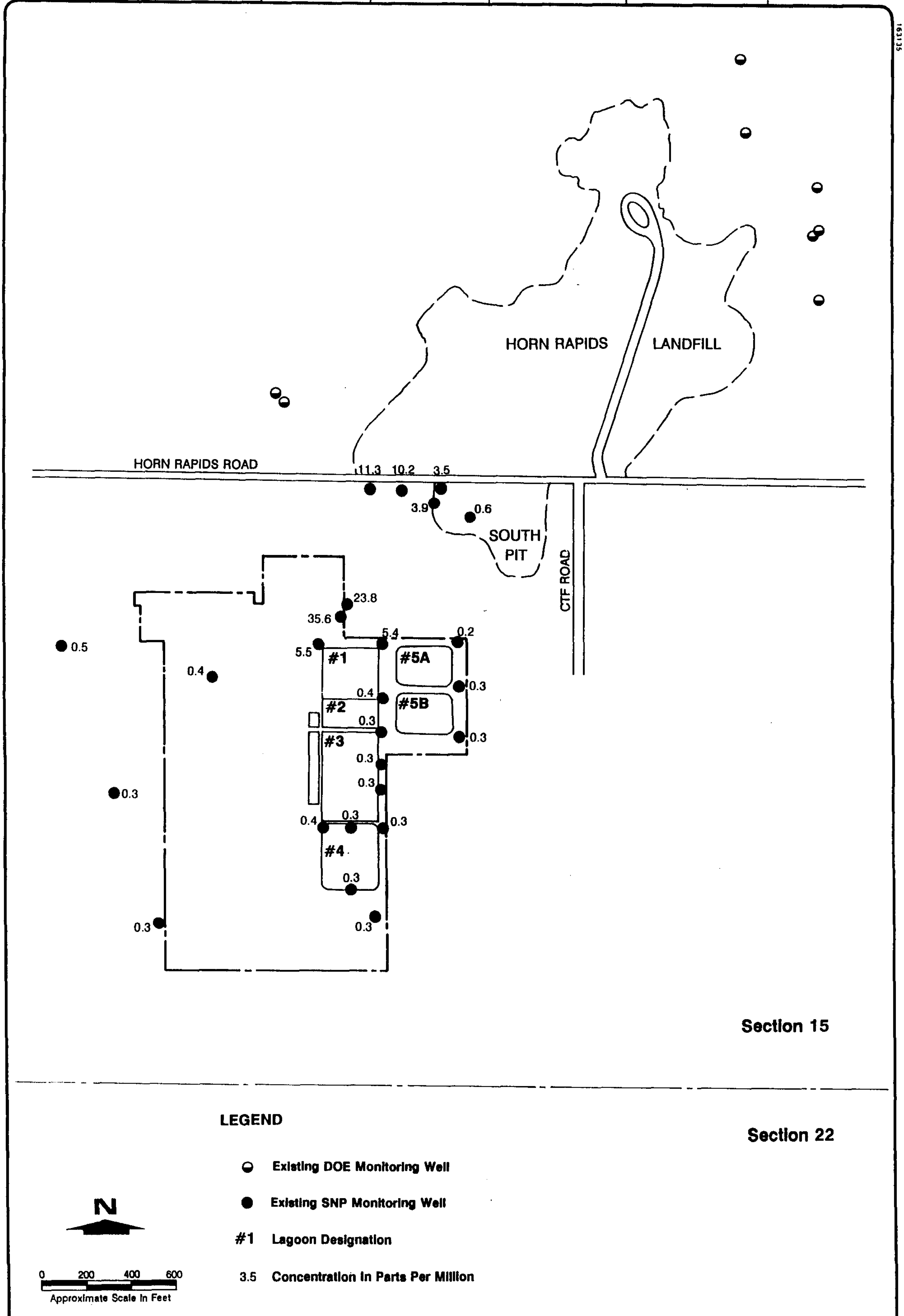
DISTRIBUTION OF AMMONIA AS NITROGEN IN GROUND-WATER SAMPLES, AUGUST 1991

Siemens Nuclear Power Corporation
Richland, Washington

FIGURE **8**

DWG DATE: JULY 1991 | PRJCT NO.: WA183.03 | FILE NO.: | DRAWING: | CHECKED: | APPROVED: PJW | DRAFTER: SAC



LEGEND

- Existing DOE Monitoring Well
- Existing SNP Monitoring Well
- #1 Lagoon Designation
- 3.5 Concentration In Parts Per Million

GERAGHTY & MILLER, INC.
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DISTRIBUTION OF FLUORIDE IN GROUND-WATER SAMPLES, AUGUST 1991

Siemens Nuclear Power Corporation
Richland, Washington

FIGURE **9**

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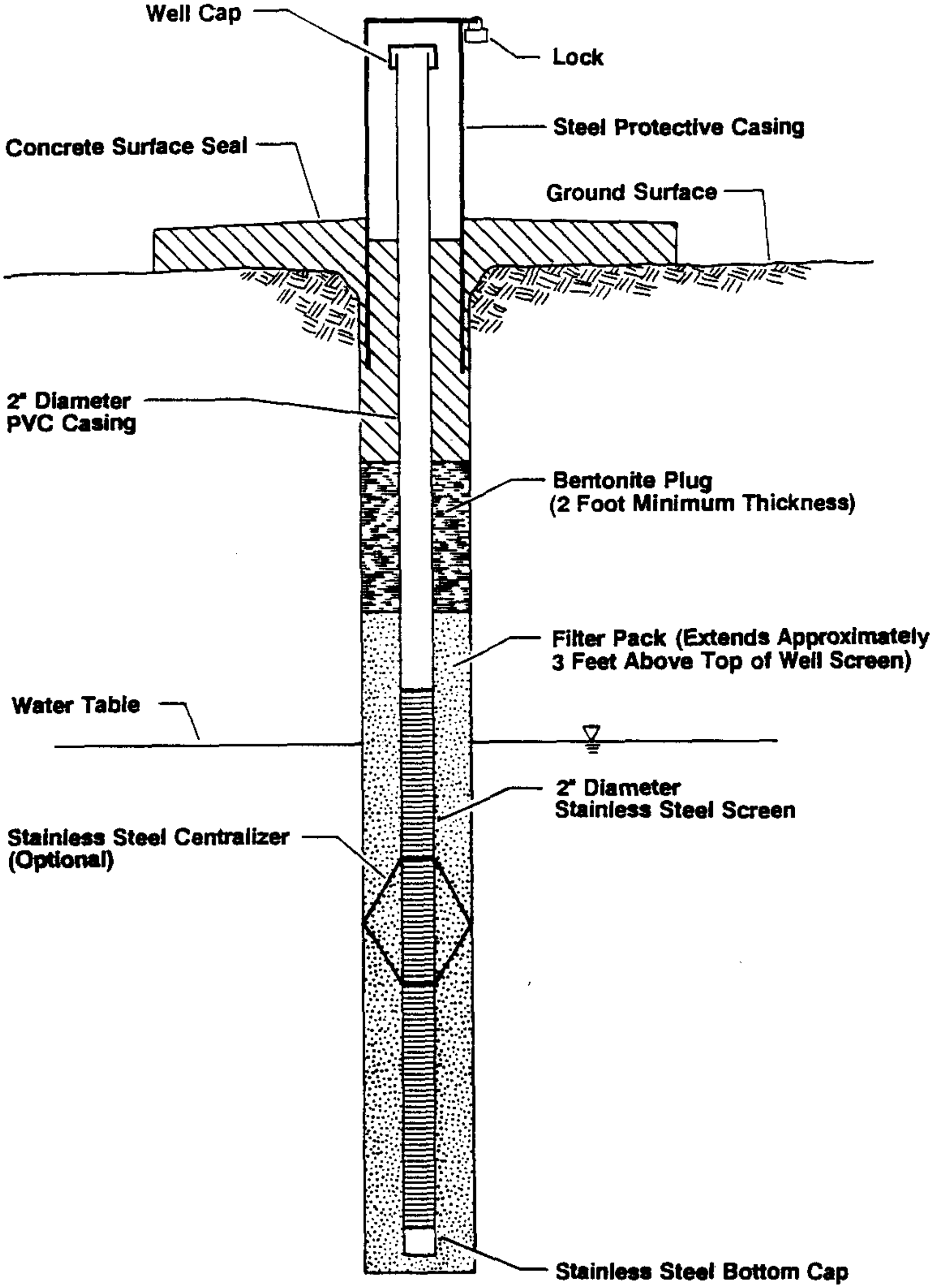

NOT TO SCALE

GERAGHTY & MILLER, INC.
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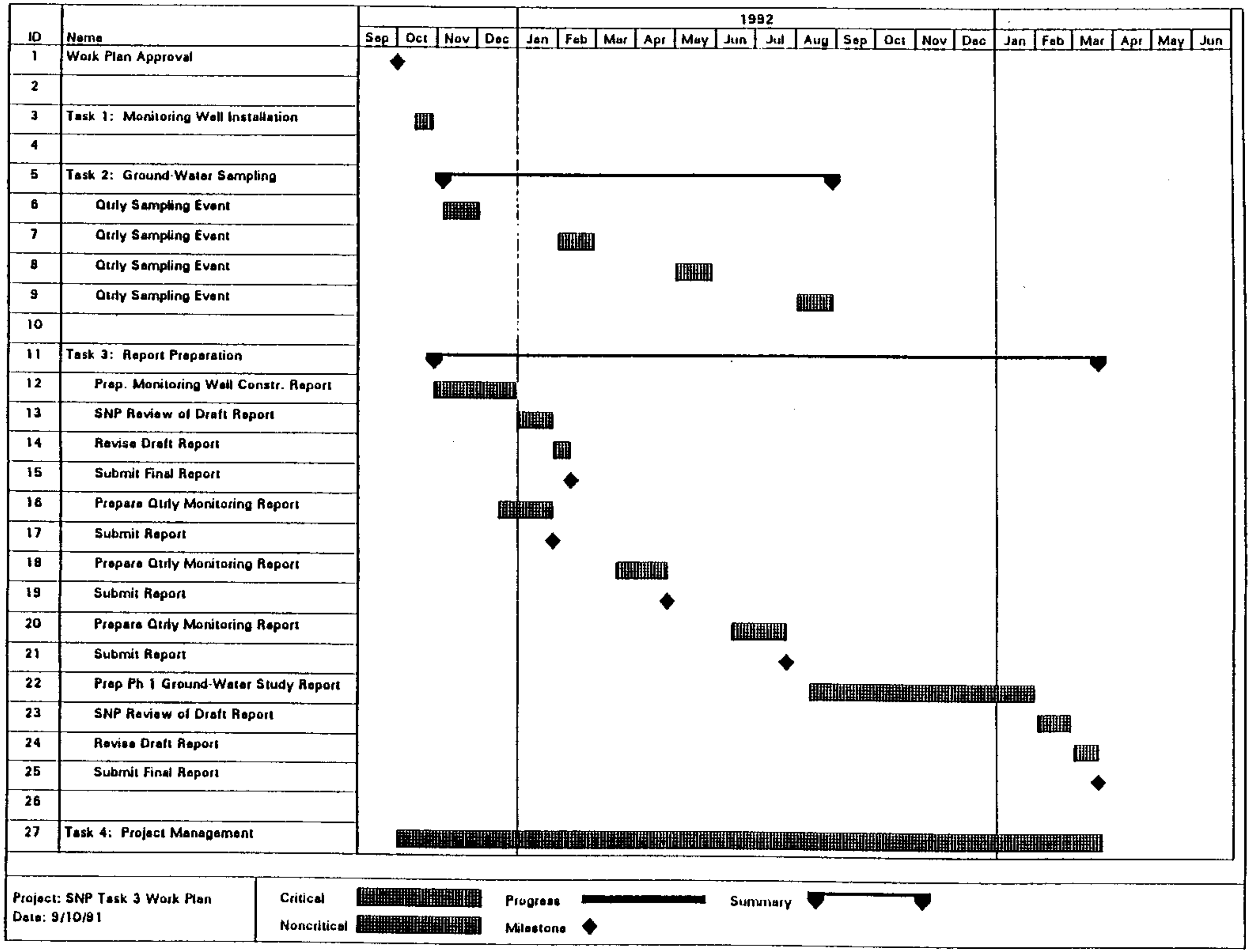
PROPOSED GROUND-WATER MONITORING WELL CONSTRUCTION

Siemens Nuclear Power Corporation
Richland, Washington

FIGURE
10

DWG DATE: JULY 1991 | PRJCT NO.: WA183.03 | FILE NO.: | DRAWING: | CHECKED: | APPROVED: PJW | DRAFTER: SAC

DWG DATE: SEPT. 1991 | PRJCT NO.: WA183.03 | FILE NO.: | DRAWING: | CHECKED: | APPROVED: PJW | DRAFTER: SAC



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PRELIMINARY SCHEDULE FOR PHASE I STUDY

Siemens Nuclear Power Corporation
Richland, Washington

FIGURE 11

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APPENDIX A

SAMPLING AND ANALYSIS PLAN

SAMPLING AND ANALYSIS PLAN

PHASE I GROUND-WATER STUDY
SIEMENS NUCLEAR POWER CORPORATION
RICHLAND, WASHINGTON

September 19, 1991

Prepared for

Siemens Nuclear Power Corporation
2102 Horn Rapids Road
Richland, Washington 99352

Prepared by

Geraghty & Miller, Inc.
Environmental Services
8330 154th Avenue NE
Redmond, Washington 98052
(206) 869-6321

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SAMPLING AND ANALYSIS PLAN

PHASE I GROUND-WATER STUDY
SIEMENS NUCLEAR POWER CORPORATION
RICHLAND, WASHINGTON

INTRODUCTION

This Sampling and Analysis Plan (SAP) was prepared by Geraghty & Miller, Inc. as part of the Phase I Ground-Water Study Work Plan (the Work Plan) for the Siemens Nuclear Power Corporation (SNP) fuel fabrication facility in Richland, Washington. The purpose of the SAP is to establish policies and procedures for project organization, data quality objectives, and sample collection and analysis activities to be conducted during the implementation of the Work Plan. The SAP fulfills the requirements for sampling and analysis plans as specified in the Washington State Model Toxics Control Act (MTCA) (WAC 173-340-820). The SAP was developed in conjunction with the Quality Assurance Project Plan (QAPP) provided in Appendix B of the Work Plan.

Soil samples will be collected during monitoring well installation, and quarterly ground-water monitoring will be initiated after well completion. Chemical data obtained through the sampling and analysis program will be used to characterize the distribution of chemical constituents in ground water at the SNP site. In addition, the data will be used to assess the potential contribution of SNP to ground-water contamination at the U.S. Department of Energy (USDOE) Horn Rapids Landfill (HRL) located north-northeast of the SNP site. Therefore, it is essential to generate data that are scientifically defensible and directly comparable to data generated by the USDOE for the HRL site. Data comparability will be accomplished by using well construction methods, field procedures, and analytical methods which are consistent, as appropriate, with those used by USDOE.

PROJECT ORGANIZATION AND RESPONSIBILITIES

The Geraghty & Miller Project Manager will oversee all aspects of the investigation under the direction of SNP. Sampling and analysis activities will be under the direction of the Field Supervisor and overseen by the Project Manager. The selection of an analytical laboratory will be based upon the results of an evaluation and review process implemented by Geraghty & Miller.

DATA QUALITY OBJECTIVES

As discussed above, it is imperative that data collected during the Phase I Ground-Water Study be scientifically defensible and directly comparable to data generated by the USDOE for the HRL site. The overall quality assurance objective is to ensure that data of known and defensible quality are obtained during the study. To achieve that objective, all field activities related to sampling will be conducted in accordance with the methods described herein. Data quality objectives are discussed in detail in the QAPP (Appendix B of the Work Plan).

SAMPLING PROCEDURES

The following procedures are to be used by all field personnel when conducting sampling activities at the SNP site. Because it is important that all data generated during the study be directly comparable to data generated by USDOE, many of the field procedures are consistent with the methods used by Westinghouse Hanford Company (WHC) as defined by Environmental Investigations Instructions (EII) in the Environmental Investigations and Site Characterization Manual (WHC 1988). Applicable EIIs are referenced and paraphrased in the sections below.

All field activities will be documented in a bound field notebook using a pen with permanent black ink. Information to be recorded in the notebook includes the following:

- Date
- Weather conditions
- Names of the field team members
- Times of site arrival and departure
- Documentation of all field activities
- Equipment malfunction
- Odd or unusual occurrences
- Site visitors

The field notebook will be signed by the Field Supervisor at the end of each day of field work.

SOIL SAMPLES

Soil samples will be collected from each borehole during monitoring well installation. The purpose of soil sampling is to document the stratigraphy beneath the site and to assess the distribution of selected constituents beneath the site. Soil sampling procedures are outlined below.

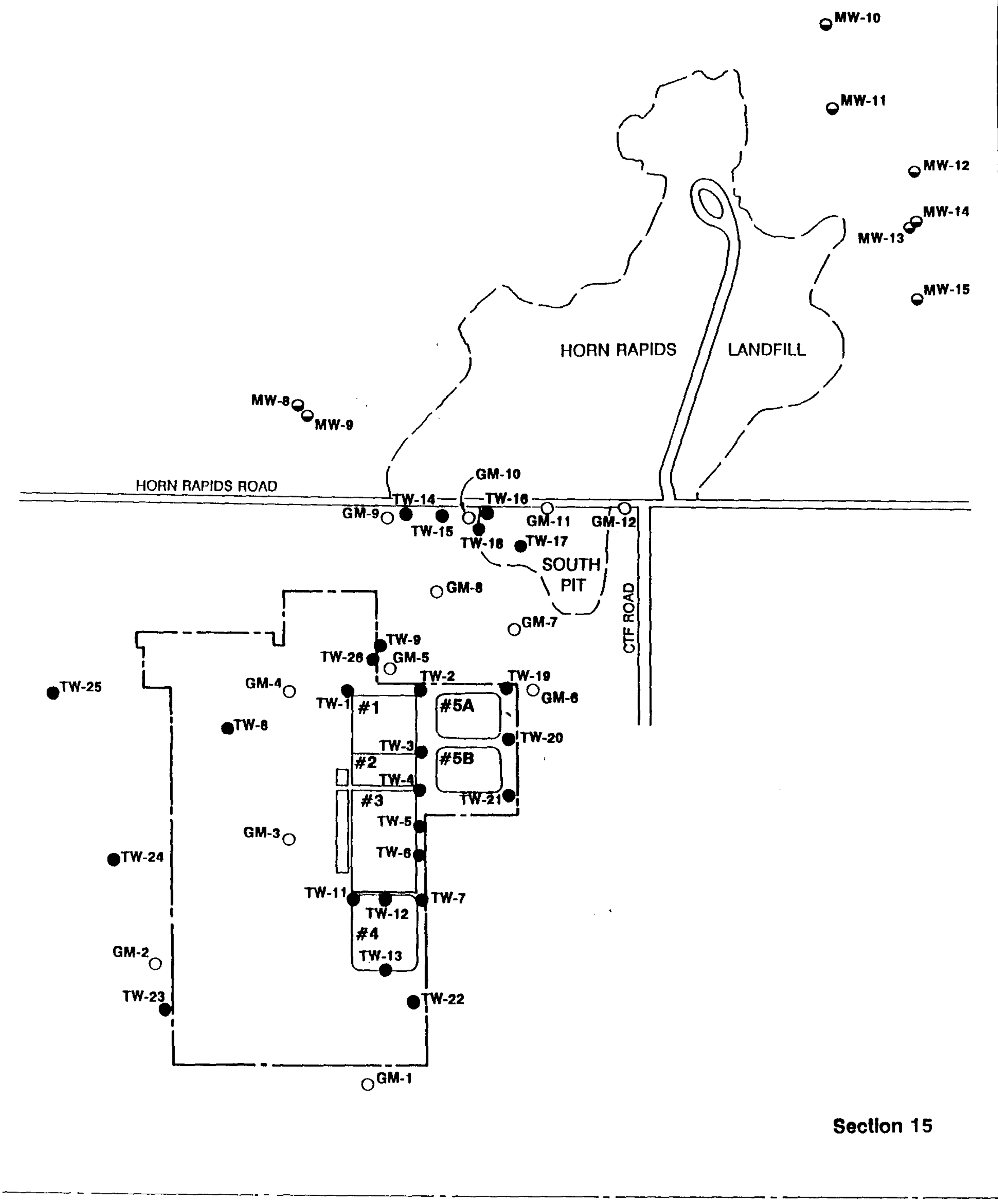
Sampling Locations

Proposed monitoring well locations are shown in Figure A-1. The rationale for each well location is discussed in the Work Plan.

Sampling Parameters and Frequency

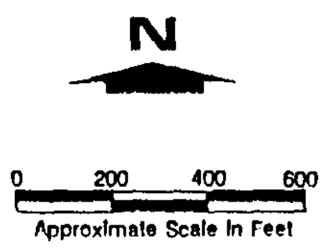
Soil samples will be collected at a minimum of 5-foot intervals during drilling and at every major change in lithology. Samples will also be collected where sand lenses or thin silt and sand layers appear in the profile. All samples will be retained for geologic

DWG DATE: JULY 1991	PRJCT NO.: WA183.03	FILE NO.:	DRAWING:	CHECKED:	APPROVED: PJW	DRAFTER: SAC



LEGEND

- Existing DOE Monitoring Well ("MW" Wells)
- Existing SNP Monitoring Well ("TW" Wells)
- Proposed SNP Monitoring Well ("GM" Wells)
- Approximate Landfill Boundary
- #1 Lagoon Designation



GERAGHTY & MILLER, INC.
Environmental Services

WELL LOCATION MAP

Siemens Nuclear Power Corporation
Richland, Washington

FIGURE
A-1

logging. Selected samples will be submitted to the laboratory for analysis of the constituents identified in Table A-1.

One soil sample from each borehole in an area where TCE has been detected in ground water will be collected and submitted to an analytical laboratory for analysis of trichloroethene (TCE). The sample will be taken at a depth immediately above the inferred depth of the seasonal high-water table (approximately 8 feet to 10 feet below land surface). TCE results will be used to assess the presence and distribution of TCE in the subsurface.

One soil sample from each borehole will be collected for grain-size analysis. The sample will be collected at a depth which corresponds to the proposed screened interval for that well. The grain-size analytical results will be used to estimate aquifer characteristics.

A limited number of soil samples will be collected from boreholes at the north end of the lagoons adjacent to locations of process waste spills. The samples will be analyzed for ammonia, fluoride, and nitrate to help characterize the extent and distribution of these constituents in the soil.

If disturbed soil is encountered during drilling, i.e., if the borehole is within the area of the South Pit, soil samples will be collected and analyzed for Target Analyte List (TAL) and Target Compound List (TCL) parameters. The number and location of samples to be submitted to the laboratory will be determined in the field. Analytical results will be used to characterize potential contamination associated with the South Pit.

TABLE A-1. SUMMARY OF SOIL SAMPLING REQUIREMENTS
PHASE I GROUND-WATER STUDY WORK PLAN
SIEMENS NUCLEAR POWER CORPORATION, RICHLAND, WASHINGTON

ANALYTE	METHOD	VOLUME OF SAMPLE REQUIRED	PRESERVATIVE	HOLDING TIME
TCE	8010	4 oz	Cool to 4 degrees centigrade	14 days
Ammonia as N	350.1	4 oz	Cool to 4 degrees centigrade	48 hours
Nitrate/Nitrite	353.2	4 oz	Cool to 4 degrees centigrade	48 hours
pH	9045	4 oz	Cool to 4 degrees centigrade	24 hours
TCL Volatile Organics	CLP	4 oz	Cool to 4 degrees centigrade	10 days
TCL Semivolatile Organics	CLP	8 oz	Cool to 4 degrees centigrade	10 days
TCL Pesticides/PCBs	CLP	8 oz	Cool to 4 degrees centigrade	10 days
TAL Inorganics	CLP	4 oz	Cool to 4 degrees centigrade	6 months
Grain Size Analysis	ASTM-D-422	100 g	NA	NA

NA Not applicable
TCL Target Compound List
TAL Target Analyte List
CLP Contract Laboratory Procedures, USEPA Contract Laboratory Program
oz ounces
g grams

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Sampling Preparation

Prior to sampling, field personnel will assemble the equipment identified in Table A-2. Equipment that will come in contact with soil will be decontaminated before each sample is collected (see Decontamination Procedures).

Sample Collection

The following soil sampling procedures are consistent with EII *5.2, Soil and Sediment Sampling*. Soil samples will be collected using a 1.5-inch diameter split-spoon sampler. The volume of soil required for each type of analysis is specified in Table A-1. The split-spoon sampler will be fitted with a series of stainless steel or brass liners. The samplers will be driven using a 140-pound hammer which will free fall from a height of 30 inches for each blow to the spoon. The number of blows required to drive the sampler 6 inches will be recorded on a Boring Log (Figure A-2) in accordance with the "Method for Penetration Test and Split-Barrel Sampling of Soils" (ASTM D 1586-84).

After removal of the split-spoon sampler, each end of the liner will be covered with aluminum foil, capped tightly, and sealed with nonadhesive, silicone rubber tape. When soil samples are taken for volatile organic analysis, disturbance to the soil sample must be minimized as much as possible. The sample container will be packed as full as possible to minimize the head space in the container. If the sample volume is insufficient to fill the liner, the sample will be transferred quickly and with minimal disturbance into a smaller-volume, precleaned glass jar and sealed with a tight fitting lid.

A sample identification label which identifies the sample number, date and time of sampling, matrix, and initials of sampling personnel will be completed and affixed to each sample container. An example of a sample label is provided in Figure A-3. The sample will be sealed in a plastic bag and stored in a cooler with wet ice or frozen reusable ice packs.

Table A-2. Soil Sampling Equipment Checklist
Phase I Ground-Water Study Work Plan
Siemens Nuclear Power Corporation, Richland, Washington

SAMPLING EQUIPMENT CHECKLIST

SAMPLING

____ 1.5-inch split-spoon sampler
____ stainless steel or brass sampling tubes
____ sample jars
____ aluminum foil
____ caps for tubes
____ Teflon™ tape
____ spoon
____ disposable surgical gloves
____ sampling caddy
____ sample labels
____ Ziploc™ bags
____ coolers
____ ice
____ waterproof pens
____ sharpies
____ soil/sediment sampling logs
____ boring logs

DECONTAMINATION

____ buckets
____ distilled water
____ liquinox
____ DI sprayer
____ detergent sprayer
____ scrub brushes
____ green nitrile gloves
____ paper towels

SAMPLE TRANSPORT

____ chain-of-custody forms
____ lab task order
____ chain-of-custody seals
____ sealing tape
____ shipping labels

MISCELLANEOUS

____ field file box
____ first aid kit
____ toolbox
____ field notebook

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BORING LOG

GERAGHTY & MILLER, INC. Environmental Services	PROJECT NO. ______ DATE ______ CLIENT ______ LOCATION ______ LOGGED BY ______ DRILLER ______	BORING NO. ___ WELL NO. ___ SHEET ___ OF ___

FIELD LOCATION OF BORING:	DRILLING CONTRACTOR ______ DRILLING METHOD ______ HOLE DIA. ______ CASING DIA. ______				
	DATE				
	TIME				
	WATER LEVEL				

Well Construction	Time	Blows/6 in.	Headspace PID/OVA	Sample ID (* = lab sample)	Depth	Sample Interval	USCS Code	SAMPLE/CORE DESCRIPTION E.g., group name; % range each size (from coarse to fine), shape & angularity of each; grading for coarse/consistency for fine; color; structure; moisture; odor; comments.

FIGURE A-2: EXAMPLE OF A BORING LOG

GERAGHTY & MILLER, INC.
Environmental Services

GERAGHTY & MILLER, INC. Environmental Services	SAMPLE I.D.	
PROJECT #		DATE
SAMPLE TYPE ☐ Soil/Sediment ☐ Water	COLLECTION MODE ☐ Composite ☐ Grab	TIME
ANALYSIS		
SAMPLER(S)	PRESERVATIVE	

FIGURE A-3: EXAMPLE OF A SAMPLE LABEL

<u>Sample Documentation</u>

Sampling information will be recorded on a Boring Log (Figure A-2). A Soil/Sediment Sampling Log (Figure A-4) will be completed for each sample submitted to the laboratory for analysis.

GROUND-WATER SAMPLES

Ground-water samples will be collected on a regular basis from the newly installed monitoring wells to characterize the distribution and concentration of selected constituents in the ground water and to assess the overall ground-water quality at the SNP site. Ground-water sampling procedures are outlined below.

<u>Sampling Locations</u>

Proposed monitoring well locations are shown in Figure A-1. The rationale for each well location is discussed in the Work Plan.

<u>Sampling Parameters and Frequency</u>

A ground-water sample will be collected from each well 1 to 2 weeks after the last well has been completed, and all wells will be sampled quarterly thereafter for 1 year. Quarterly sampling at the SNP site will coincide with quarterly sampling by USDOE at the HRL. The frequency of sampling may be increased in some wells after review of initial analytical results.

Ground-water samples will be analyzed for the constituents identified in Table A-3. Volatile organic constituents and metals will be analyzed using U.S. Environmental Protection Agency (EPA) Contract Laboratory Program (CLP) methods. All other constituents will be analyzed using standard EPA methods. Criteria used to

GERAGHTY & MILLER, INC.
Ground-Water Consultants

SOIL/SEDIMENT SAMPLING LOG

Project No. ______________________ Page ____ of ____

Site Location ______________________

Sample ID No. ______________________ Coded/Replicate No. ____________

Date ______________________ Time of Sampling: Begin ________ End ________

Weather ______________________

Site Description ______________________

____

____

SAMPLING DATA

Collection Method ______________________

Depth ____________ Moisture Content ____________ pH ______

Color ____________ Odor ____________

Description ______________________

____

____

Analyses Required	Container

Sample Monitoring (TIP, OVA, HNU, etc.) ____________

____

____

Remarks ______________________

____

Sampler(s) ______________________

FIGURE A-4: EXAMPLE OF A SOIL/SEDIMENT SAMPLING LOG select the constituents were based upon a review of existing ground-water quality data from SNP and HRL, a review of the list of constituents from known releases, and the need for general water-quality information.

Sampling Preparation

Prior to sampling, field personnel will assemble the equipment identified in Table A-4. All equipment will be checked for proper operation. Equipment that will come into contact with ground water will be decontaminated before use (see Decontamination Procedures below). Field testing equipment (pH/conductivity meter, thermometer) will be tested and calibrated before each day of sampling (see Calibration Procedures below).

Sample containers will be provided by the laboratory and will contain the appropriate preservatives (Table A-3). Extra sets of bottles will be included in case of breakage. Sample bottles will be counted before leaving for the field.

The Field Supervisor will make arrangements for site access prior to leaving for the sampling location. Upon arrival at the SNP site, the field team will check in at the security gate and with a SNP representative. At that time, field personnel can be apprised of site conditions.

Samples will be collected first from wells with little or no known contamination to reduce the potential for cross-contamination between wells. Upon arrival at the sampling location, the field vehicle will be parked downwind of the well. Field personnel will not smoke, drink, or eat during sampling and will avoid handling any objects not necessary for performing sampling procedures. Clean nitrile or vinyl gloves will be worn when handling any field equipment or samples. Gloves will be changed or decontaminated as necessary to prevent cross-contamination.

TABLE A-3. SUMMARY OF GROUND-WATER SAMPLING REQUIREMENTS
PHASE I GROUND-WATER STUDY WORK PLAN
SIEMENS NUCLEAR POWER CORPORATION, RICHLAND, WASHINGTON

ANALYTE	EPA METHOD	CONTAINER	PRESERVATIVE (1)	HOLDING TIME
Volatile Organics	624	2x40 ml glass vial	HCl to pH < 2, cool 4 C	14 days
Ammonia as Nitrogen	350.2	1-L amber glass	H2SO4 to pH < 2, cool 4 C	28 days
Dissolved metals (2)	200.7	1-L Polyethylene	HNO3 to pH < 2, cool 4 C	6 months
Chloride	300.0	1-L Polyethylene	Cool 4 C	28 days
Fluoride	300.0	1-L Polyethylene	Cool 4 C	28 days
Phosphate	300.0	1-L Polyethylene	H2SO4 to pH < 2, cool 4 C	28 days
Nitrate as Nitrogen	300.0	1-L Polyethylene	Cool 4 C	48 hours
Sulfate	300.0	1-L Polyethylene	Cool 4 C	28 days
Alkalinity	310.1	1-L Polyethylene	Cool 4 C	14 days
Acidity	305.1	1-L Polyethylene	Cool 4 C	14 days
Gross alpha	900.0	1-L Polytheylene	HNO3 to pH < 2, cool 4 C	6 months
Gross beta	900.0	1-L Polytheylene	HNO3 to pH < 2, cool 4 C	6 months
Temperature	NA	NA	NA	NA
pH	NA	NA	NA	NA
Specific conductance	NA	NA	NA	NA

(1) 'Cool 4 C' indicates that sample must be cooled to 4 degrees centigrade
(2) Barium, calcium, iron, magnesium, manganese, potassium, sodium
ml Milliliters
L Liter
NA Not applicable
HCl Hydrochloric Acid
H2SO4 Sulfuric Acid
HNO3 Nitric Acid

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Table A-4. Ground-Water Sampling Equipment Checklist
Phase I Ground-Water Study Work Plan
Siemens Nuclear Power Corporation, Richland, Washington

SAMPLING EQUIPMENT CHECKLIST

WELL PURGING

- ____ pump
- ____ pump control box
- ____ discharge hose
- ____ generator (Honda 5000)
- ____ extension cord
- ____ m-scope and steel tape
- ____ sounding line
- ____ calculator
- ____ strap or bungie cord

SAMPLING

- ____ plastic sheeting
- ____ bailer cord
- ____ latex surgical gloves
- ____ Teflon™ or stainless steel bailers
- ____ Teflon™ spigot
- ____ sampling caddy
- ____ glass or Teflon™ beaker
- ____ pH/conductivity meters (2)
- ____ extra batteries for meter
- ____ thermometer (2)
- ____ sample bottles
- ____ sample labels
- ____ coolers
- ____ ice
- ____ waterproof pens
- ____ sharpies
- ____ water sampling logs

DECONTAMINATION

- ____ pump decontamination tubs
- ____ buckets (3 or 4)
- ____ distilled water
- ____ liquinox
- ____ DI sprayer
- ____ detergent sprayer
- ____ scrub brushes
- ____ green nitrile gloves
- ____ trash bags
- ____ paper towels

SAMPLE TRANSPORT

- ____ chain-of-custody forms
- ____ lab task order
- ____ chain-of-custody seals
- ____ sealing tape
- ____ shipping labels

MISCELLANEOUS

- ____ well and gate keys
- ____ measuring tape
- ____ Ziploc™ bags (large and small)
- ____ field file box
- ____ first aid kit
- ____ toolbox
  - ____ utility knife/scissors
  - ____ screwdrivers
  - ____ tiny screwdriver
  - ____ pliers
  - ____ fishing hooks
- ____ field notebook

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Calibration Procedures

All field equipment requiring calibration will be calibrated to known standards prior to being used in the field. Instruments and standards to be used while conducting field work during the Phase I Ground-Water Study are the following:

Instrument	Calibration Standard
pH meter	pH 4.0, 7.0, and 10.0 buffer solutions
Specific conductance meter	Dry air, 1413 μmhos/cm solution of potassium chloride
Electric water-level probe	Weighted steel tape marked in 0.01 feet increments

Standard operating procedures for calibration of the pH and specific conductance meters will be stored in the carrying cases with the meters. An entry in the Calibration Log (Figure A-5), also stored in the carrying case, will be completed each time the instrument are calibrated. Readings on two thermometers will be compared to assess proper calibration; temperature readings may also be compared with the temperature meter on the pH or specific conductance probe. If equipment cannot be calibrated or becomes inoperable due to damage, its usage will be discontinued until the necessary repairs are made. In the interim, a calibrated replacement will be obtained and used. It is the responsibility of the Field Supervisor to ensure that all instruments are properly maintained and in working order prior to use in the field.

Ground-Water Level Measurements

The static water level in all monitoring wells will be measured with an electric probe or a weighted steel tape prior to sampling any wells. At least one round of water-level measurements will be made with both a steel tape and an electric probe.

CALIBRATION/MAINTENANCE LOG

EQUIPMENT DESCRIPTION ______________________________

EQUIPMENT MANUFACTURER AND MODEL ______________________________

SERIAL NO. ______________________________

Date	Description of Calibration Medium Used/ Maintenance Performed	Calibration Readings	Batteries*	Initials

*Batteries Replaced/Recharged

100.4OFC:CALIBLOG.FRM

FIGURE A-5: EXAMPLE OF A CALIBRATION LOG

QUALITY ASSURANCE PROJECT PLAN

PHASE I GROUND-WATER STUDY
SIEMENS NUCLEAR POWER CORPORATION
RICHLAND, WASHINGTON

INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been developed as part of the Phase I Ground-Water Study Work Plan (the Work Plan) for the Siemens Nuclear Power Corporation (SNP) fuel fabrication facility in Richland, Washington. The objectives of the Phase I Ground-Water study are summarized as follows:

1. Initial characterization of the ground-water flow system.

2. Initial characterization of the distribution of contaminants in ground water.

3. Assessment of the relative contributions of SNP, the South Pit, and the Horn Rapids Landfill (HRL) to ground-water contamination at the HRL.

4. Collection of scientifically and legally defensible data.

5. Fulfillment of potential regulatory requirements and guidelines for site characterization, monitoring well construction, and sampling and analysis.

The above-referenced objectives will be achieved through the implementation of the following four tasks:

1. Monitoring well installation.
2. Ground-water monitoring.
3. Data interpretation and report preparation.
4. Project management.

The QAPP specifies the methods which will be used to ensure that defensible, high-quality data are generated during the implementation of the Work Plan.

PROJECT QUALITY ASSURANCE

Project quality assurance (QA) will be the responsibility of the Quality Assurance Manager. The QA Manager will verify the implementation of quality control (QC) procedures and initiate corrective action, if necessary. Laboratory quality assurance and quality control (QA/QC) will be the responsibility of the contracted lab. The laboratory QAPP is on file at the Geraghty & Miller Seattle, Washington office.

DATA QUALITY ASSURANCE AND QUALITY CONTROL

The generation of high-quality data during the implementation of the Work Plan will be assured through thorough planning, strict adherence to the Work Plan, complete documentation of all project activities, and oversight of project activities by the Project Manager and the QA Manager. QA/QC procedures for field and laboratory activities are specified in the following sections.

FIELD ACTIVITIES

Field personnel will not deviate from the Work Plan without prior approval from the Project Manager or Field Supervisor. The Project Manager or Field Supervisor will make routine visits to the project site to evaluate the performance of field personnel and observe field operations in progress. The Field Supervisor or Project Manager will observe the performance of the field team at least once during each type of activity, i.e., monitoring well installation, water-level measurements, and ground-water sampling.

Field data will be validated through the review of the documentation of field procedures in the field notebook, boring logs, and sampling logs.

To verify QC of field procedures, trip blanks and equipment blanks will be submitted to the laboratory for chemical analysis. Trip blanks consist of sample containers filled in the laboratory with laboratory-grade analyte-free water, transported to and from the site in sample coolers, and analyzed for the same organic constituents as the samples. The trip blank is not opened in the field and is intended to detect contamination resulting from transportation or field conditions.

Equipment blanks consist of sample containers that have been filled in the field with analyte-free water that has been poured through decontaminated sampling equipment (i.e., bailer or split-spoon sampler). The equipment blank is analyzed for the same constituents as the samples to verify the effectiveness of decontamination procedures. Equipment blanks will be collected at the end of each sampling day to detect any accumulation of cross-contamination.

Instruments used to measure field parameters will be calibrated against known standards to ensure accurate results. Field calibration procedures and standards are discussed in the Sampling and Analysis Plan.

LABORATORY ACTIVITIES

Data Quality Objectives

The analytical methods, detection limits, and data quality objectives formulated for this study (Table B-1) are consistent with those stated in the Remedial Investigation Phase 2 Supplemental Work Plan for the Hanford Site [U.S. Department of Energy (DOE) 1991], which includes work at the HRL. This approach will result in data of sufficient quality to (1) be technically sound, (2) allow comparison between DOE and SNP data sets, and (3) be legally defensible.

TABLE B-1. SUMMARY OF ANALYTES, METHODS, AND DATA QUALITY OBJECTIVES FOR GROUND-WATER MONITORING
PHASE I GROUND-WATER STUDY WORK PLAN
SIEMENS NUCLEAR POWER CORPORATION, RICHLAND, WASHINGTON

ANALYTE	METHOD	CRQL (1)	G&M QA LEVEL (2)	PRECISION CRITERIA (3)	ACCURACY CRITERIA (3)
Volatile Organics	624 (4)	2 ug/l	IV	25	75-125
Ammonia as Nitrogen	350.3 (5)	50 ug/l	III	20	75-125
Barium	200.7 (5)	200 ug/l	IV	20	75-125
Calcium	200.7 (6)	5000 ug/l	IV	20	75-125
Iron	200.7 (6)	100 ug/l	IV	20	75-125
Magnesium	200.7 (6)	5000 ug/l	IV	20	75-125
Manganese	200.7 (6)	15 ug/l	IV	20	75-125
Potassium	200.7 (6)	5000 ug/l	IV	20	75-125
Sodium	200.7 (6)	5000 ug/l	IV	20	75-125
Chloride	300.0 (7)	10000 ug/l	III	20	75-125
Fluoride	340.2 (8)	100 ug/l	III	20	75-125
Nitrate as Nitrogen	300.0 (7)	100 ug/l	III	20	75-125
Phosphate	300.0 (7)	500 ug/l	III	20	75-125
Sulfate	300.0 (7)	2000 ug/l	III	20	75-125
Alkalinity	310.1 (5)	10000 ug/l	III	20	75-125
Acidity	305.1 (5)	10000 ug/l	III	20	75-125
Gross alpha	900.0 (9)	7.5 pCi/l	III	20	75-125
Gross beta	900.0 (9)	25 pCi/l	III	20	75-125
Temperature	(10)	NA	NA	NA	NA
pH	(10)	NA	NA	NA	NA
Specific conductance	(10)	NA	NA	NA	NA

(1) CRQL is the contract-required quantitation limit; values are to be considered requirements in the absence of known or suspected analytical interferences.
(2) Level IV reporting includes a full laboratory report as required by the USEPA Contract Laboratory Program (CLP). Level III reporting includes a full CLP data package except for raw spectra and laboratory bench data sheets used to prepare quality assurance documents.
(3) Precision is expressed as a relative percent difference between results of duplicate or replicate analyses; accuracy is expressed as percent recovery of an analyte. These limits apply to sample results greater than five times the CRQL and are to be considered requirements in the absence of known or suspected analytical interferences.
(4) Method described in 40 CFR 136, Appendix A.
(5) Method described in Methods for Chemical Analysis of Water and Wastes, EPA 600/4-79-020, 1979.
(6) Method described in 40 CFR 136, Appendix C.
(7) Method described in Determination of Inorganic Anions in Aqueous and Solid Samples of Ion Ion Chromatography, EPA-600/4-84-017, 1984.
(8) Method described in Methods for Chemical Analysis of Water and Wastes, EPA 600/4-79-020, 1979, Revised 1983.
(9) Method described in Prescribed Procedures for Measurement of Radioactivity in Drinking Water, EPA-600/4-80-032, 1980.
(10) Measured in the field according to instrument manufacturer's instructions.
ug/l Micrograms per liter
pCi/l Picocuries per liter
NA Not applicable

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Data quality objectives for detection limits, precision, and accuracy have been established for each ground-water monitoring parameter, where possible. (Data quality objectives have not been established for soil samples). In addition, QC limits have been specified for data completeness. QC procedures for ensuring data representativeness are described in the Sampling and Analysis Plan. Precision, accuracy, completeness, and representativeness are defined as follows:

Precision is the measure of a laboratory's ability to obtain reproducible results. Precision of analytical results is determined by analyzing duplicate or replicate samples and statistically comparing the results. Precision is most commonly evaluated by calculating the relative percent difference (RPD) between the two measured values.

Accuracy is the measure of the degree of agreement between a measured value and the true or expected value. Accuracy is determined by spiking samples with known concentrations of standard compounds and comparing the analytical results with the known concentrations. Accuracy is statistically represented by percent recovery (%R) and percent difference (%D) from the known true value of a standard compound. Accuracy is also assessed by analyzing calibration verification samples.

Completeness is defined as the ratio of the number of valid QC results to the total number of QC samples of a specific type analyzed. Completeness is expressed as a percentage.

Representativeness is the degree to which data accurately and precisely represent a characteristic of a population parameter, variations at a sampling point, or an environmental condition. Representativeness is the qualitative parameter that is most concerned with the proper design of a sampling and analysis program.

Data quality objectives for precision and accuracy are defined in Table B-1. The data quality objective for completeness for this study is 90 percent of QC criteria met for measures of precision and accuracy. The sections below describe how the laboratory assesses precision and accuracy.

Analytical precision is assessed in the laboratory by the analysis of duplicate or replicate samples. Duplicate samples collected in the field will be submitted at a frequency of no less than 1 per 20 samples. The laboratory will not be informed of the duplicate nature of the samples. In addition, laboratory duplicates or spike duplicates will be analyzed at the rate of 1 per 20 samples.

Analytical accuracy is assessed in the laboratory through the analysis of blank spikes, matrix spikes, surrogate spikes, and method blank samples. A blank spike is prepared by adding (spiking) a known amount of an analyte standard to lab reagent water prior to sample preparation. Matrix spike samples are prepared by spiking a known amount of the analytes of interest or designated spiking compounds into a sample prior to sample preparation, then prepared and analyzed along with the other samples in the batch. To monitor the preparation and analysis of samples, surrogate spikes, used in organic analyses only, are prepared by adding special compounds at known concentrations into all samples, blanks, standards, and control samples; they are analyzed in a batch prior to sample preparation. Method blanks are samples of deionized laboratory reagent water prepared and analyzed along with the samples to verify that no sample contamination has resulted from the preparation process. QC samples that verify accuracy will be analyzed at a frequency of no less than 1 per 20 samples. One method blank will be analyzed with each batch of samples.

Laboratory calibrations procedures, calibration frequency, and standards for measurement variables and systems will be conducted in accordance with the U.S. Environmental Protection Agency Contract Laboratory Program (EPA CLP) requirements, as applicable. Laboratory QC procedures are outlined in the laboratory QAPP.

Data Reduction, Validation, and Reporting

The laboratory will be required to submit analytical results that are supported by sufficient QC data to enable data reviewers to conclusively assess the validity of the data. The EPA CLP data package for volatile organic and metals analyses provides the required documentation. Relevant QC data for ancillary analyses will be provided by the laboratory.

All the QC data provided by the laboratory will be validated by the QA Manager prior to data analysis. Appropriate data qualifier codes (J, U, B, and R, as denoted below) will be applied to those data for which QC results do not meet acceptable standards. Data will be validated using the EPA Laboratory Data Validation Functional Guidelines for Organic and Inorganic Analyses (EPA 1988a and 1988b). Data qualifier codes are interpreted as follows:

J Code: For data flagged with a "J", the sample have failed some of the analytical QC requirements, but not enough to warrant classifying the data as unusable. Data receiving a "J" flag are considered to be qualitative (data are estimated values), provided the field data meet all criteria and the sample is valid.

U Code: A "U" indicates that the sample was analyzed, but the analyte was not detected, i.e., the concentration of the analyte was below the detection limit.

B Code: Data flagged with a "B" indicate those samples in which the analyte was detected in a laboratory blank.

R Code: Data flagged with an "R" indicate those samples which have not met the required data quality objectives and the analytical QC requirements. These data are unusable even if field QC is acceptable.

PREVENTATIVE MAINTENANCE

Preventative maintenance of equipment is essential to maximize project resources and cost effectiveness and to minimize down time. Preventative maintenance will be implemented as follows:

1. The proper operation of field equipment will be verified prior to its use in the field.

2. Equipment will be cleaned and, if necessary, repaired after use and before it is returned to storage.

3. Calibration procedures will be regularly performed and documented.

4. Spare equipment and spare parts will taken to the field to the degree practical, and the availability of critical spare parts and equipment will be researched prior to the initiation of field activities.

CORRECTIVE ACTION

Corrective actions fall into two categories: (1) correcting field equipment malfunctions and (2) correcting nonconformance or noncompliance with the established QA/QC requirements. During the field operations and sampling procedures, the Field Supervisor will be responsible for correcting equipment malfunctions and verifying that the procedures specified in the Work Plan have been carried out by all field personnel. The QA Manager is responsible for verifying that laboratory QC criteria have been met.

If the stated procedures have not been followed, the Field Supervisor or QA Manager should report nonconformance to the Project Manager and make recommendations for corrective action. All corrective measures taken in the field will be documented in the field notebook, and all corrective actions undertaken to meet project objectives will be documented in the final report.

The analytical laboratory is required to adhere to standard operating procedure guidelines as specified in the CLP. Corrective actions are specified in the laboratory QAPP.

slowly into the well. When the electric probe registers contact with the ground water, the reading on the tape at the measuring point will be noted to the nearest 0.01 feet.

Each water-level measurement will be recorded on a Ground-Water Level Measurement form (Figure A-6), together with the date and time of the measurement, the type and serial number of the measuring device, and the initials of the person taking the measurement. The water-level measurement will also be recorded on the Water Sampling Log (Figure A-7).

The steel tape or electric probe will be decontaminated before the first measurement and between measurements with distilled water and a clean towel.

Total Depth Measurement

The total depth of each well will be measured prior to sampling. The total depth will be measured from the measuring point at the top of the casing by lowering a weighted tape or cable until the weight is felt resting on the bottom of the well. Appropriate weights will be available and used to provide accurate definition of the total well depth. Measurements will be recorded to the nearest 0.2 feet on the Water Sampling Log (Figure A-7).

The total depth measurements will be used to confirm that the proper well has been identified, that the well has not filled with silt, and to accurately calculate the volume of water standing in the well. The well will be redeveloped if more than 1 foot of silt has accumulated in the bottom of the well.

The sounding line will be decontaminated between each measurement with a laboratory-grade, nonphosphate detergent and rinsed with deionized or distilled water.

GROUND-WATER LEVEL MEASUREMENTS
SIEMENS NUCLEAR POWER CORPORATION, RICHLAND, WASHINGTON

Type and Serial Number of Measuring Device: ______________________

Field Team: ______________________

Well ID	Date	Time	Elevation of Measuring Point (ft msl)	Water Level (ft btopc)	Water-Level Elevation (ft msl)
GM-1					
GM-2					
GM-3					
GM-4					
GM-5					
GM-6					
GM-7					
GM-8					
GM-9					
GM-10					
GM-11					
GM-12					
TW-1	367.00				
TW-2	370.00				
TW-3	369.52				
TW-4	371.04				
TW-5	371.13				
TW-6	366.15				
TW-7	367.15				
TW-8	372.44				
TW-9	367.84				
TW-11	373.12				
TW-12	374.15				
TW-13	375.07				
TW-14	370.25				
TW-15	370.65				
TW-16	376.77				
TW-17					
TW-18					
TW-19	381.15				
TW-20	381.43				
TW-21	380.47				
TW-22	374.95				
TW-23	373.25				
TW-24	373.36				
TW-25	371.92				
TW-26	367.70				

ft msl feet below mean sea level

ft btopc feet below top of casing

FIGURE A-6. GROUND-WATER LEVEL MEASUREMENT FORM

GERAGHTY & MILLER, INC.
Environmental Services

WATER SAMPLING LOG

Project/No. ______________________ Page______ of______

Site Location ______________________

Site/Well No. ______________ Coded/ Replicate No. ______________ Date ______________

Weather ______________ Time Sampling Began ______________ Time Sampling Completed ______________

EVACUATION DATA

Description of Measuring Point (MP) ______________________

Height of MP Above/Below Land Surface ______________ MP Elevation ______________

Total Sounded Depth of Well Below MP ______________ Water-Level Elevation ______________

Held ________ Depth to Water Below MP ______________ Diameter of Casing ______________

Wet ________ Water Column in Well ______________ Gallons Pumped/Bailed Prior to Sampling ______________

Gallons per Foot ______________

Gallons in Well ______________ Sampling Pump Intake Setting (feet below land surface) ______________

Evacuation Method ______________________

SAMPLING DATA/FIELD PARAMETERS

Color__________ Odor__________ Appearance__________ Temperature __________ °F/°C

Other (specific ion; OVA; HNU; etc.) ______________________

____

Specific Conductance, umhos/cm______________ pH______________

Sampling Method and Material ______________________

Constituents Sampled	Container Description From Lab _____ or G&M _____	Preservative

Remarks ______________________

Sampling Personnel ______________________

WELL CASING VOLUMES				
GAL./FT.	1-¼" = 0.06 1-½" = 0.09	2" = 0.16 2-½" = 0.26	3" = 0.37 3-½" = 0.50	4" = 0.65 6" = 1.47

G&M Form 12 6-86 Southport 89-1473

FIGURE A-7: EXAMPLE OF A WATER SAMPLING LOG

Well Purging

Well purging procedures will be consistent with those outlined in EII *5.8, Groundwater Sampling*. The volume of water standing in the well will be calculated by subtracting the depth-to-water measurement from the total depth of the well and multiplying the result by the number of gallons per linear foot of water in the well. The gallons per linear foot is a function of the well casing diameter and is obtained from values tabulated on the Water Sampling Log (Figure A-7). A minimum of three well volumes will be purged from each well using a nondedicated submersible pump prior to sampling. All calculations will be recorded on the Water Sampling Log.

The pH, specific conductance, and temperature of the discharged water will be measured at least three times during purging (after each well volume is removed). The pH will be considered stable when two consecutive measurements agree within 0.2 standard units. Temperature will be considered stable when two consecutive measurements agree within 0.2 degrees centigrade, and specific conductance will be considered stable when two consecutive readings are within 10 percent of each other. If the pH, temperature, and specific conductance do not stabilize within the designated purging time, then purging will continue until the readings have stabilized or until the Field Supervisor indicates that further purging is unnecessary.

The purge water will be pumped into 55-gallon drums and held on-site pending analytical results to ensure proper disposition. The date, well identification, and drum identification number will be clearly marked on the outside of each drum using a permanent marker. A log of each drum, the volume of purge water that it contains, and its location will be maintained in the field notebook.

Sample Collection

Sampling procedures will be consistent with EII *5.8, Groundwater Sampling*. Samples will be collected using a Teflon™ bailer rather than a pump. After the well has been purged, the pump will be removed from the well and decontaminated (see Decontamination Procedures). A Teflon™ bailer on a clean nylon cord will be slowly lowered into the well, filled, and raised to the surface. Care will be taken to prevent the agitation of ground water in the well. The water will be collected in the bailer and discarded twice before collecting a sample. The bailer will be emptied with a bottom-emptying Teflon™ spigot.

Caps on the sample containers will be left in place until just before filling. When the cap is removed from the sample container, care will be taken not to touch the lip of the bottle, the inside of the Teflon™ cap, or the mouth of the Teflon™ spigot.

The sample bottle will be filled slowly by placing the mouth of the spigot against the inner side of the sample bottle to prevent trapping any air bubbles. Care will be taken to avoid splashing or agitating the water while the bottle is being filled.

For bottles requiring zero headspace (for volatile organic analyses), the bottle will be filled completely so that a meniscus forms over the mouth. The bottle will be capped immediately, turned upside-down, and tapped a few times to check for air bubbles in the sample. If a bubble exists, the sample will be discarded and the sampling procedure will be repeated until a bubble-free sample is obtained.

For samples collected for analyses of dissolved constituents, the sample will be decanted from the bailer into a clean Teflon™ or glass beaker. The sample will be drawn through clean silicone tubing and a 0.45-micron filter using a battery-powered peristaltic pump and into a sample bottle containing an acid preservative.

After each sample bottle is filled and capped, a sample label which identifies the sample number, date and time of sampling, matrix, type of preservative, and initials of sampling personnel will be affixed to the sample container. An example of a sample label is provided in Figure A-3. Samples will be placed in a cooler with wet ice or frozen reusable ice packs for storage and transport to the laboratory.

Field parameters (pH, temperature, and specific conductance) will be measured by filling a Teflon™ or glass beaker with a ground-water sample and placing the probes and a thermometer in the beaker. Measurements will be recorded on the Water Sampling Log (Figure A-7). The color, odor, appearance, and other observations about the sample will also be recorded on the Water Sampling Log.

Quality Control Samples

Quality control samples to be collected in the field include equipment rinsate blanks, duplicate samples, and trip blanks. Quality control samples will be collected at a frequency of no less than 1 per 20 samples.

Equipment rinsate blanks will be collected by pouring analyte-free, deionized water through a decontaminated sampling bailer and filling sample bottles for a full suite of analyses. Duplicate samples will be collected by filling two sets of sample bottles with ground water from a single well. Each bailer of water will be divided evenly between two bottles for a single type of analysis. Trip blanks will be prepared by the laboratory and will not be opened during sampling. Trip blanks will be analyzed for volatile organic constituents. Quality control samples and procedures are discussed further in the QAPP provided in Appendix B of the Work Plan.

Sample Documentation

All sampling activities shall be documented in the field notebook. A Water Sampling Log (Figure A-7) shall be completed for each sample and will document well evacuation procedures and sampling data.

DECONTAMINATION PROCEDURES

Reusable sampling equipment, including the equipment used to measure field parameters, will be decontaminated prior to use and after each sampling event to avoid chemical cross-contamination of field samples. Equipment will be decontaminated by washing with a laboratory-grade, nonphosphate detergent and rinsing with distilled or deionized water. Wash and rinse water will be disposed of appropriately.

Interior and exterior surfaces of the submersible pump and associated discharge tubing will be decontaminated after each use by operating the pump in a container filled with a laboratory-grade, nonphosphate detergent solution and then in a container filled with potable water.

All field personnel will wear clean nitrile or vinyl gloves when conducting decontamination procedures.

SAMPLE HANDLING AND SHIPMENT PROCEDURES

SAMPLE PRESERVATION AND STORAGE

The types of bottles and preservatives required for each type of soil and ground-water analysis are identified in Tables A-1 and A-3. All soil and water samples will be stored in a cooler with wet ice or frozen reusable ice packs immediately after collection. The ice will be distributed evenly so that all samples are in physical contact with the ice.

The cooler of filled sample containers will be transported by courier to the laboratory for analysis.

CHAIN-OF-CUSTODY PROCEDURES

Sample custody is a vital aspect of ground-water monitoring studies because these types of programs generate data that may be used as evidence in a court of law. The samples must be traceable from the time of sample collection until the time the data are introduced as evidence in legal proceedings.

All samples will remain in the custody of the sampling personnel during each sampling day. At the end of each sampling day and prior to the transfer of the samples to the courier, chain-of-custody entries will be made for all samples using a chain-of-custody form (Figure A-8). One chain-of-custody form will be completed for each cooler of samples. All information on the chain-of-custody form and the sample container labels will be checked against the sampling log entries, and samples will be recounted before transferring custody. Upon transfer of custody to the courier, the chain-of-custody form will be signed by a member of the field team, sealed in plastic, and taped to the inside lid of the cooler.

A signed, dated custody seal (Figure A-9) will be placed over the lid opening of the sample cooler to indicate if the cooler is opened during shipment. All chain-of-custody forms received by the laboratory must be signed and dated by the laboratory's sample custodian.

The custodian at the laboratory will note the condition of each sample received as well as questions or observations concerning sample integrity. The sample custodian will also maintain a sample-tracking record that will follow each sample through all stages of laboratory processing. The sample tracking records must show the date of

FIGURE A-8: EXAMPLE OF A CHAIN-OF-CUSTODY FORM

GERAGHTY & MILLER, INC.
Ground-Water Consultants

CHAIN-OF-CUSTODY RECORD

Page______ of ______

Project Number ________________

Project Location ________________

Laboratory ________________

Sampler(s) ________________

____

SAMPLE IDENTITY	Date Sampled	SAMPLE BOTTLE / CONTAINER DESCRIPTION										TOTAL

Total No. of Bottles/ Containers ______

Relinquished by: __________	Organization: __________	Date __/__/__ Time ______	Seal Intact?
Received by: __________	Organization: __________	Date __/__/__ Time ______	Yes No N/A
Relinquished by: __________	Organization: __________	Date __/__/__ Time ______	Seal Intact?
Received by: __________	Organization: __________	Date __/__/__ Time ______	Yes No N/A

Special Instructions/Remarks: ________________________

Delivery Method: ☐ In Person ☐ Common Carrier __________ (SPECIFY) ☐ Lab Courier ☐ Other __________ (SPECIFY)

G&M Form 09 A 11 87

Southprint 87 2867

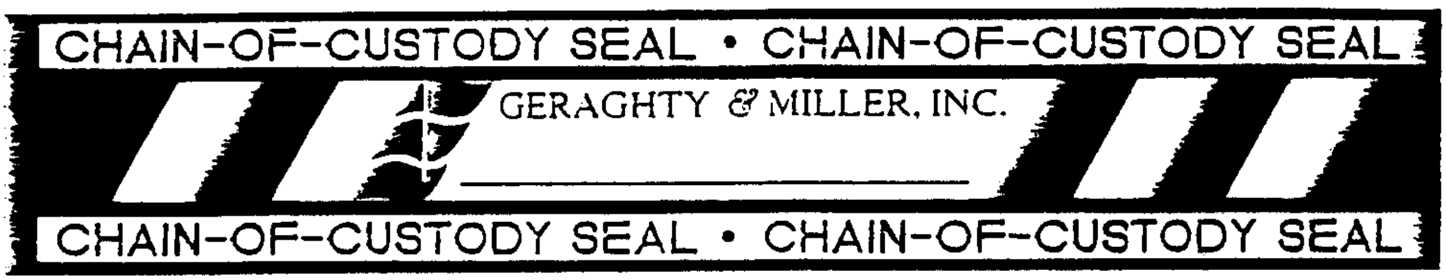

FIGURE A-9:EXAMPLE OF A CHAIN-OF-CUSTODY SEAL sample extraction and sample analysis. These records will be used to determine compliance with holding time limits during laboratory audits and data validation.

SOIL SAMPLES

The analytical procedures to be conducted on soil samples are specified in Table A-1. Grain-size analysis will be performed on one soil sample from each borehole.

GROUND-WATER SAMPLES

The analytical procedures to be conducted on ground-water samples are specified in Table A-3. Temperature, pH, and specific conductance will be measured in the field according to instrument manufacturers' instructions.

Laboratory protocol, quality control procedures, and data reporting requirements are discussed in the QAPP (Appendix B of the Work Plan).

DATA VALIDATION PROCEDURES

Analytical results will be reviewed and validated by a Geraghty & Miller Quality Assurance Manager. Appropriate data qualifier codes will be applied to those data for which quality control parameters do not meet acceptable standards. Data quality acceptance criteria are specified in the EPA Laboratory Data Functional Guidelines (EPA 1988a and 1988b). Data validation procedures are discussed in detail in the QAPP (Appendix B of the Work Plan).

REFERENCES

U.S. Environmental Protection Agency (EPA). 1988a. Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses, February 1988.

__________. 1988b. Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses, July 1988.

Westinghouse Hanford Corporation. 1988. Environmental Investigations and Site Characterization Manual, WHC-CM-7-7, August 1988.

APPENDIX B

QUALITY ASSURANCE PROJECT PLAN

QUALITY ASSURANCE PROJECT PLAN

PHASE I GROUND-WATER STUDY
SIEMENS NUCLEAR POWER CORPORATION
RICHLAND, WASHINGTON

September 19, 1991

Prepared for

Siemens Nuclear Power Corporation
2101 Horn Rapids Road
Richland, Washington 99352

Prepared by

Geraghty & Miller, Inc.
Environmental Services
8330 154th Avenue NE
Redmond, Washington 98052
(206) 869-6321

CONTENTS

TABLE

Measurement methods will be consistent with EII *10.2, Measurement of Groundwater Levels*.

Water levels in all wells will be measured on the same day to obtain the most accurate representation of the water table. A minimum of two consistent measurements will be taken at each well to confirm the accuracy of the measurement. Measurements will be considered consistent if they are within +/- 0.02 feet of each other when using a weighted steel tape and within +/- 0.04 feet of each other when using an electric probe.

A measuring point shall be established at the top of the well casing and shall be clearly and permanently marked. The point will be surveyed to establish the elevation with reference to an established datum. Depth-to-water measurements shall be made from this point.

The weighted steel tape is the more accurate method for measuring ground-water levels. Prior to lowering the tape into the well, the lower 3-foot segment will be chalked with carpenter's chalk or water-indicating paste. The tape will be lowered into the well until the water surface is penetrated and a marked increment on the tape coincides with the measuring point on the well casing. The tape reading at the measuring point will be noted, and the tape will be withdrawn from the well without letting the tape go deeper into the well than the hold point. The reading at the demarcation between the dry and wet portions of the bottom of the tape will be noted. This value will be subtracted from the tape reading taken at the measuring point to obtain the total depth-to-water measurement.

To measure water levels using an electric probe, the proper operation of the electric probe will be verified prior to measurement by inserting the probe into water to ensure that contact is clearly indicated on the meter. The probe will then be lowered

REFERENCES

U.S. Environmental Protection Agency (EPA). 1988a. Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses, February 1988.

__________. 1988b. Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses, July 1988.

APPENDIX C

HEALTH AND SAFETY PLAN

HEALTH AND SAFETY PLAN*

SIEMENS NUCLEAR POWER CORPORATION
RICHLAND, WASHINGTON

September 20, 1991

Prepared by

GERAGHTY & MILLER, INC.
8330 154th Avenue Northeast
Redmond, Washington 98052

**This Health and Safety Plan has largely retained the components of the Health and Safety Plan section from Hart Crowser, 1991, Work Plan Ammonium Hydroxide Release of July 11, 1991, Advanced Nuclear Fuels Corporation, Richland, Washington, April 9, 1991.*

CONTENTS

TABLES

FIGURES

HEALTH AND SAFETY PLAN

EMERGENCY CONTINGENCY INFORMATION

LOCATION	Siemens Nuclear Power Corporation 2101 Horn Rapids Road Richland, Washington 99352-0130 (509)375-8500
HOSPITAL	The nearest hospital is Kadlec Hospital located at: 888 Swift Boulevard Richland, Washington (509)946-4611 See Figure C-1 for map of route to Kadlec Hospital.
EMERGENCY RESPONDERS	Police Department .... 911 Fire Department .... 911 Ambulance .... 911 Kadlec Hospital .... (509)946-4611
EMERGENCY CONTACTS	Geraghty & Miller, Susan Keith .... (206)869-6321 Geraghty & Miller, Anneliese Ripley ...... (206)869-6321 Siemens Nuclear Power, Chuck Malody .... (509)375-8537 National Response Center .... (800)424-8802 EPA Environmental Response Team ...... (201)321-6660 Chemtrec .... (800)424-9300 Centers for Disease Control .... Day (404)329-3311 .... Night (404)329-3644 Medical Emergency (National Service) ..... (513)421-3063

In the event of an emergency, call for help as soon as possible. Give the following information:

- **Where** the emergency is, using cross streets or landmarks.
- **Phone number** from which you are calling.
- **What happened** and the type of injury.
- **How many** persons need help.
- **What** is being done for the victim(s).
- **You hang up last**, letting the person you called hang up first.

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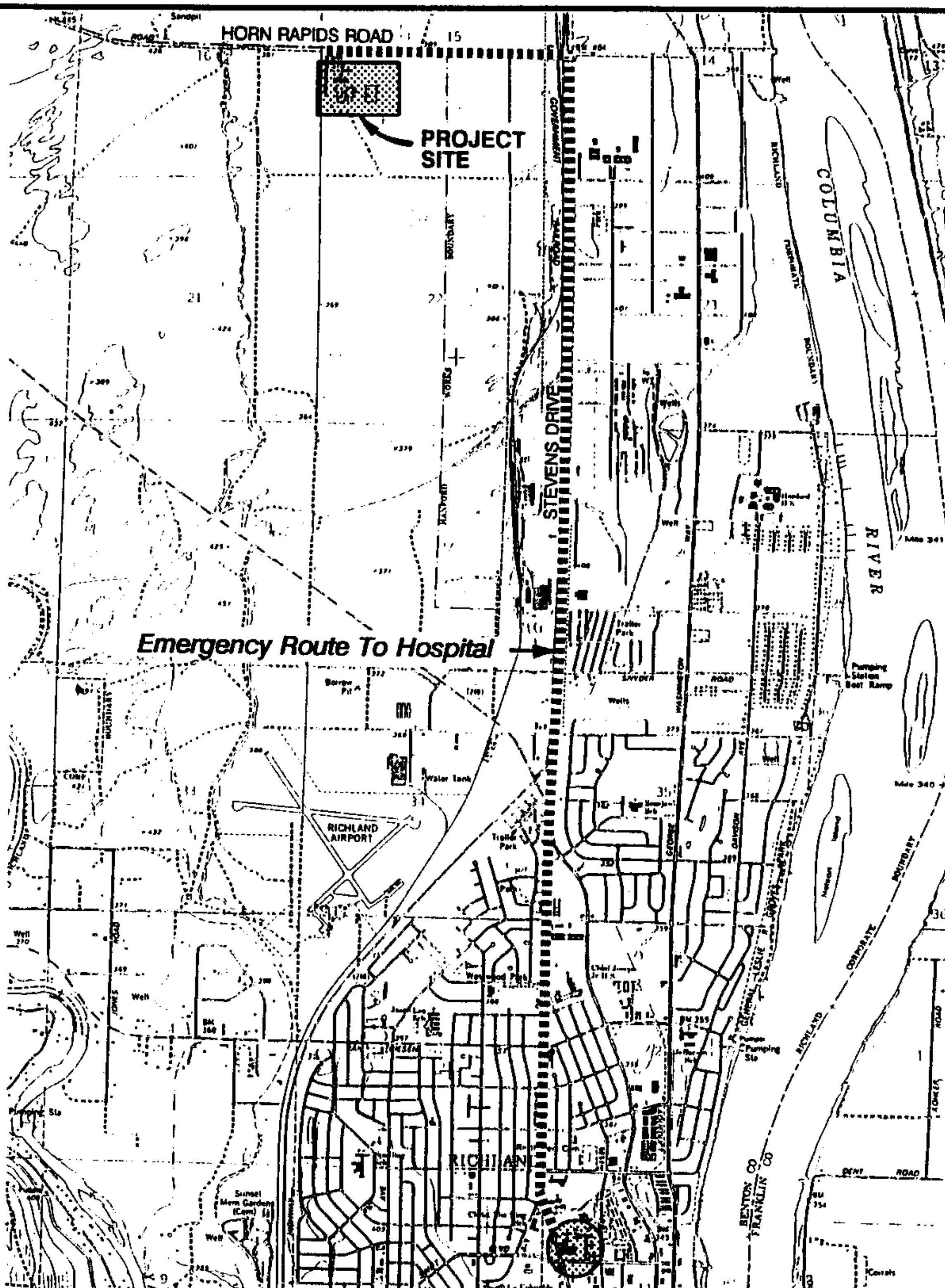

SOURCE: USGS 7.5 Minute Topographic Map, RICHLAND, WASHINGTON Quadrangle, Dated 1978.

0 3500 7000

Approximate Scale in Feet

DRAFTER: SAC | APPROVED: PJW | CHECKED: | DRAWING: | FILE NO.: | PRJCT NO.: WA183.03 | DWG DATE: SEPT. 1991

GERAGHTY & MILLER, INC.
Environmental Services

EMERGENCY ROUTE TO HOSPITAL

Siemens Nuclear Power Corporation
Richland, Washington

FIGURE
C-1

SITE HEALTH AND SAFETY PLAN SUMMARY

- **Location:** Siemens Nuclear Power Corporation, 2101 Horn Rapids Road, Richland, Washington
- **Proposed Dates of Activities:** October 1991 through March 1993
- **Type of Facility:** Nuclear fuels production
- **Size of Site:** 36 acres (fenced)
- **Land Use of Area Surround Facility:** Industrial
- **Area Population:** Immediate area is industrial site
- **Potential Site Contamination:** Ammonium hydroxide; gross alpha and gross beta radiation
- **Routes of Entry:** Skin contact with soil or ground water; possible airborne dust or vapor inhalation
- **Protective Measures:** Engineering controls, protective suits, coveralls, gloves, boots, and respirators (if required)
- **Monitoring Equipment:** Draeger with ammonia detection tubes, and a Geiger-Müller counter equipped with a pancake probe
- **Factors Prompting Site Activities:** Evaluation of wastewater release contamination

BACKGROUND INFORMATION

The health and safety plan (HASP) addresses procedures designed to eliminate injuries and accidents as well as to minimize chemical-exposure risks to on-site workers at the Siemens Nuclear Power (SNP) Corporation facility in Richland, Washington during the environmental assessment activities described in this work plan and in the work plan for the soils investigation (in preparation). The facility location is depicted on Figure C-2.

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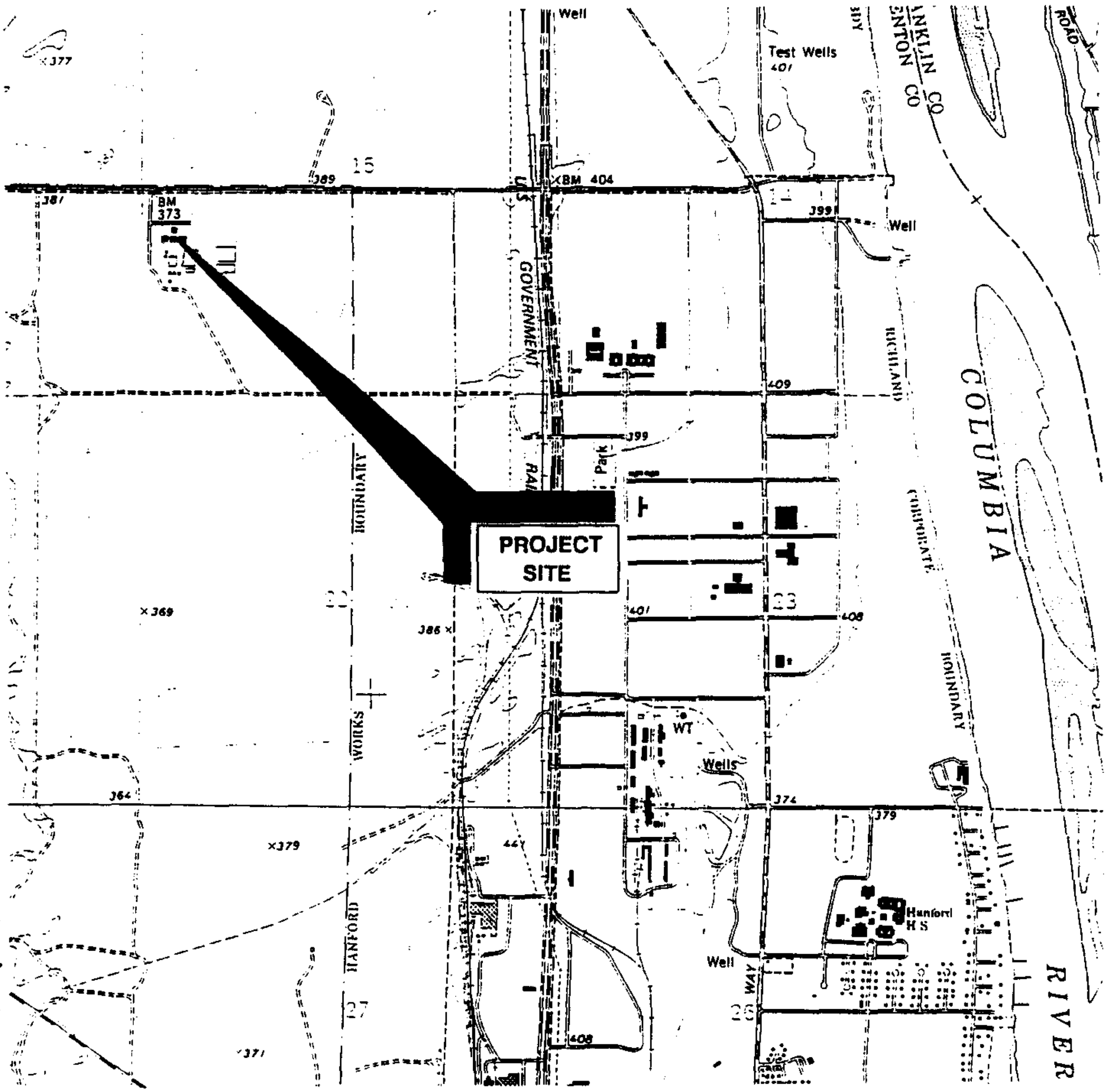
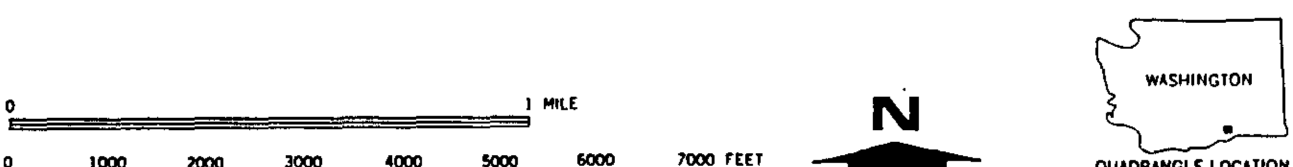


SOURCE: USGS 7.5 Minute Topographic Map, RICHLAND, WASHINGTON Quadrangle, 1978.



DRAFTER: SAC
APPROVED: LER
CHECKED:
DRAWING:
FILE NO.:
PROJECT NO.: WA183.02
ORIG DATE: JULY 1991

GERAGHTY & MILLER, INC.
Environmental Services

SITE LOCATION MAP

Siemens Nuclear Power Corporation
Richland, Washington

FIGURE
C-2

The primary objectives of the Phase I Ground-Water Study are to characterize the ground-water flow system and distribution of contaminants in ground water. Field activities to be conducted during the study include monitoring well installation, soil sample collection, and ground-water sample collection.

The soils investigation is to define the vertical and lateral extent of soil contamination resulting from a release of process wastewater from an underground pipe on July 11, 1989. Field activities in this investigation include the excavation of boreholes and collection of soil samples.

The provisions set forth in this plan will apply to the employees of Geraghty & Miller, Inc. and their subcontractors working on the project. The subcontractors may elect to modify the provisions, but only to upgrade or increase the safety activities and only with the concurrence of Geraghty & Miller as designated and accepted in writing. This HASP does not provide override, but may be considered an addendum to a more stringent HASP prepared by SNP.

KEY PERSONNEL AND RESPONSIBILITIES

OFFICE SAFETY MANAGER

- Revise Hart Crowser Health and Safety Plan to meet Geraghty & Miller Corporate safety standards.
- Communicate requirements to Project Safety Manager.

PROJECT SAFETY MANAGER

- Assist in development of Geraghty & Miller Site Health and Safety Plan.
- Communicate requirements to Field Safety Manager and field personnel and subcontractors.

- Consult with Office Safety Manager regarding new site conditions which arise and subsequent changes in this plan.

FIELD SAFETY MANAGER

- Implement health and safety requirements in the field.
- Communicate requirements to field personnel and subcontractors.
- Consult with Project and Office Safety Managers regarding new or unanticipated site conditions.

HAZARD EVALUATION

The Work Plans for the SNP facility includes the following tasks:

- Installation of monitoring wells
- Excavation of boreholes
- Collection of soil and ground-water samples

In some cases these tasks may involve potential physical hazards as well as potential adverse health effects due to contaminant exposure, as discussed in the following sections. A specific hazard analysis is included below.

PHYSICAL HAZARDS

Cold Stress

Most of the field activities discussed in the work plans will be conducted during the fall and winter months. Cold stress may be of concern, especially when a wind-chill-adjusted temperature of 10°F or less is expected. It is important for field personnel to recognize the early sings and symptoms of cold stress so that preventative measures can be taken. Preventative measures include personal protective equipment and work practices.

Recognizing the symptoms of cold stress is of the utmost importance. Field personnel may all be subjected to the same environmental conditions, but as individuals, will have different susceptibilities to cold stress due to many factors. These factors include age, physical fitness, degree of acclimatization, and the specific task we are performing. The early signs of cold stress are as follows: Shivering, severe shaking, rigid muscles, slurred speech, memory lapses, incoherence, and drowsiness.

Frostbite can also occur from exposure to extremely low temperatures. The most vulnerable parts of the body are the nose, cheeks, ears, fingers, and toes. Symptoms of frostbite include the following:

- The skin changes color, to white or grayish-yellow, then to reddish-violet, and finally to black as the tissue dies.
- Pain may be felt at first, but subsides.
- Blisters may appear.
- The affected part is cold and numb.

Hypothermia is the lowering of the body's core temperature as a result of exposure to cold climates and/or working conditions. Hypothermia can occur before frostbite.

Personal protective equipment and protective clothing are essential. The correct clothing depends on the specific cold stress situation. To preserve the air space between the body and the outer layer of closing is important for retaining body heat. Wearing clothing in multilayers is preferred; it produces more air pockets that provide better insulation. Clothing worn under personal protective equipment should be made of thin cotton fabric, which helps evaporate sweat by picking it up and bringing it to the surface. The insulating effect is negated if the clothing interferes with the evaporation of sweat or if the skin or clothing become wet. The most important parts of the body to protect and the face, head, hands, and feet.

Working in cold areas causes significant water loss through the skin and lungs as a result of the dryness of the air. Increased fluid intake is essential to prevent dehydration. Warm, sweet, caffeine-free, nonalcoholic drinks and soups should be made available for fluid replacement and caloric energy. The body needs a certain amount of salt and other electrolytes to function properly. However, using salt tablets is not recommended. Anyone with high blood pressure or who is on a sodium-restricted diet should consult a physician for advice.

Heat Stress

Although most of the field activities discussed in the work plans will be conducted during the fall and winter months, some sampling activities will occur in the summer when ambient air temperatures in the Richland area on average register in the upper 90s (degrees Fahrenheit). Hot ambient air in conjunction with poorly ventilated protective clothing worn by field workers may contribute to heat stress, resulting in cramps, exhaustion, or stroke.

Heat cramps are muscular pains and spasms which occur from heavy exertion. The cause of such cramps is thought to be due to loss of bodily water and salt. If such cramping occurs, the victim should be taken to a cool area and administered small doses of water until cramping ceases.

Heat exhaustion may result from overexertion in a warm, humid climate. Symptoms of heat exhaustion include heavy sweating; cool, moist, pale skin; dilated pupils; nausea; dizziness; and vomiting. Field workers suffering from heat exhaustion should be taken to a cool place to lie down and administered wet compresses and small doses of water.

Heat stroke results when a person's temperature control system stops working and they stop sweating. Heat stroke is life threatening and should be treated immediately. Symptoms of heat stroke include hot-red skin, small pupils, and a high body temperature. Field workers suffering from heat stroke should be taken to a cool area and cooled with clean water. No fluids should be administered to a victim until emergency medical help arrives.

A supply of drinking water should be kept near the work area at all times and workers should take breaks as often as necessary to minimize heat stress effects.

Heavy Machinery/Trips/Falls

As with all similar work sites, caution will be exercised to prevent injury while working around heavy equipment such as drill rigs. Work areas and excavations (if any) should be marked with stanchions and plastic barrier tape to prevent injuries and falls. Appropriate barriers and guards must be in place around moving equipment to protect workers from pinch points and entrapment.

Caution should also be used to avoid slips on wet or slick surfaces. Work will not be performed on elevated platforms without fall protection. In the event that excavation should be involved, no employee will enter an excavation deeper than 5 feet without proper shoring in place.

Confined Space Entry

Confined space entry is not anticipated for this project. No confined space entry will be performed without amendment of this plan and preparation of an entry permit.

Smoking

Geraghty & Miller and subcontractor employees will not smoke on the site at any time.

Electrical Hazards

Prior to conducting any drilling activities in the study area, Underground Utilities (1-800-424-5555) will be contacted to alert utility operators to locate their underground utilities. It is the responsibility of individual property owners to locate utility lines buried on their site. If buried utility lines are encountered, drilling activities will be immediately terminated, and the boring will be relocated. In the event that the integrity of a utility line is damaged, drilling should cease immediately and the appropriate owner should be notified. No drilling operations will be conducted within 20 horizontal feet of overhead lines.

Live transformer or electrical components will **not** be sampled in this work. In the event that electrical circuits must be interrupted to perform the described work, proper lock-out and tag-out procedures will be followed as per Geraghty & Miller's *Health and Safety Manual*.

Noise

Appropriate hearing protection (ear muffs or ear plugs) will be used if high noise levels are generated. For the purpose of this investigation, hearing protection will be worn when a conversation between two individuals standing within 3 feet of each other cannot be conducted without shouting. Hearing protection will always be worn when working near an operating drill rig.

Fire and Explosion Hazard

Potentially explosive conditions can be encountered where petroleum hydrocarbons or other flammable materials or chemicals have accumulated. Although this situation is not anticipated in this project, workers will use caution and apply fire and explosion surveillance procedures in the event a potential risk is noted.

An ABC dry chemical fire extinguisher with a minimum charge of 10 pounds shall be a part of the sampling equipment brought to the site. If volatile chemical products are encountered as separate phase or vapors, this plan will be amended to address potential fire and explosion risks. Always observe basic precautions such as no smoking or creation of sparks or open flames around flammable materials.

CHEMICAL HAZARD EVALUATION

The site is known to potentially contain residual ammonium hydroxide. The chemical and toxicological properties of ammonium hydroxide pertinent to the planned activities at the SNP facility are discussed below.

Ammonium hydroxide is an aqueous solution at ordinary temperatures containing 25 percent to 29 percent ammonia with a vapor pressure of about 500 millimeters (mm) mercury at 20°C. Ammonia itself is a colorless, pungent gas with a boiling point of -33.4°C and a vapor pressure of 8.7 atmospheres at 20°C. Based on these data, aqueous ammonium hydroxide is expected to be very volatile, and inhalation of vapors can be expected to represent a significant exposure pathway if the compound is encountered on-site. Ammonium hydroxide is corrosive and can inflict burns from skin exposure.

Special or unusual circumstances may arise during drilling activities near the South Pit, as the exact boundary of the landfill is not known. Drilling operations at these locations may bring contaminated subsurface material to the surface, resulting in actual or potential chemical hazards. An addendum to this HASP will be prepared after these hazards have been more fully evaluated.

RADIATION HAZARD EVALUATION

Gross-alpha- and gross-beta-emitting radiation sources may potentially be encountered during drilling and excavation activities. Alpha particles have low-penetrating power and can be shielded from by thin barriers such as paper or skin. Alpha particles can travel approximately 4 inches in air. Beta particles have higher penetrating power and can travel up to 30 inches in air or 0.1 to 0.5 inches into skin.

The most likely exposure route to workers for alpha and beta particles is via inhalation of airborne dusts. Engineering control measures should be taken to prevent entrainment of dust and to remove airborne dust from the work area. If engineering measures fail to control dusts, tight-fitting dust masks or an air purifying respirator (APR) equipped with a MSA GMD-H cartridge should be donned by workers.

EXPOSURE ROUTES AND PROTECTIVE MEASURES

INHALATION

Given the potential contaminant and site characteristics, exposure via inhalation may occur if contaminated soils or vapors become airborne. In the event this risk is encountered, appropriate actions for controlling exposure to vapors or dust will be implemented as discussed in the Protective Measures section.

SKIN CONTACT

This route of entry could occur if contaminated soil or water contacts the skin or clothing. Dusts generated during movement of dry soils could also settle on exposed skin and clothing of site workers. Protective clothing and decontamination activities specified in the HASP will minimize the potential for skin contact with contaminants.

INGESTION

This route of entry could occur if individuals eat, drink, or perform other hand-to-mouth activities while in contaminated areas on the site. Decontamination procedures established in this plan will virtually ensure that no contaminants are ingested inadvertently.

PROTECTIVE MEASURES

Minimum personal protection level requirements are outlined in Table C-1. Disposable gloves and protective coveralls will be worn during field activities which involve potential skin contact with contaminated soil or liquids. Safety goggles or splash shields will be used whenever a splash hazard exists. A decontamination layout as detailed on Figure C-3 will be set up in the vicinity of the field work to allow appropriate cleaning of equipment before exiting the site.

If visible dust is expected to be generated during field activities at the site, engineering control measures will be used to minimize the risk of inhalation. These measures will include spraying or wetting dusts with water and positioning individuals upwind of any potential releases. If these measures are not deemed adequate to minimize dust inhalation or if ammonia vapors are present above action levels as discussed below in the air monitoring section, APRs equipped with appropriate cartridges will be utilized by field personnel in the near vicinity of the field work location. At a minimum, all field personnel working in dusty environments must wear tight-fitting disposable dust masks.

Table C-1. Minimum Personal Protection Level Requirements

Potential Route of Contact/ Contaminants	Required Protection Level	Required Equipment							
		Safety Glasses	Hard Hat	Safety Boots	Tyvec	Poly Tyvec	Nitrile Gloves	Neoprene Gloves	Full-Face Respirator
None Anticipated	Level D (a)	X	b	X					
Minor Skin Contact Possible		X	b	X	X		X		
Skin Contamination Possible	Level C (c)								
Organics		X	b	e		X	X		
Acids		d	b	e		X		X	
Bases		d	b	e		X		X	
Inorganics		X	b	e		X		X	
Inhalation Possible	Level C (c)								
Organics		X	b	e	X		X		f,g
Acids		d	b	e	X			X	f,g
Bases		d	b	e	X			X	f,g
Inorganics		X	b	e	X			X	f,g
Radioactive Particles		X	b	e	X			X	f,h

(a) Level D protection required when atmosphere contains no known hazard and work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals.
(b) Hard hat is required where risk of striking overhead objects exists.
(c) Level C protection required when the atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect any exposed skin; the types of air contaminants have been identified, concentrations measured, and an appropriate respirator cartridge is available; and all air-purifying respirator criteria are met.
(d) Goggles or full-face respirator required.
(e) chemical-resistant synthetic boots required.
(f) Appropriate respirator cartridges include organic vapor (MSA GMA or equivalent) and combination (MSA GMC-H or equivalent) or specialized cartridges such as GMD or GMC-H for ammonia, as required by contaminants.
(g) Full-face respirator required when Draeger tube concentrations range from 10 to 100 and/or eye irritation occurs or as otherwise required.
(h) Tight-fitting disposable dust mask is required when working in dusty environments, e.g., near operating drilling rigs or heavy construction equipment.

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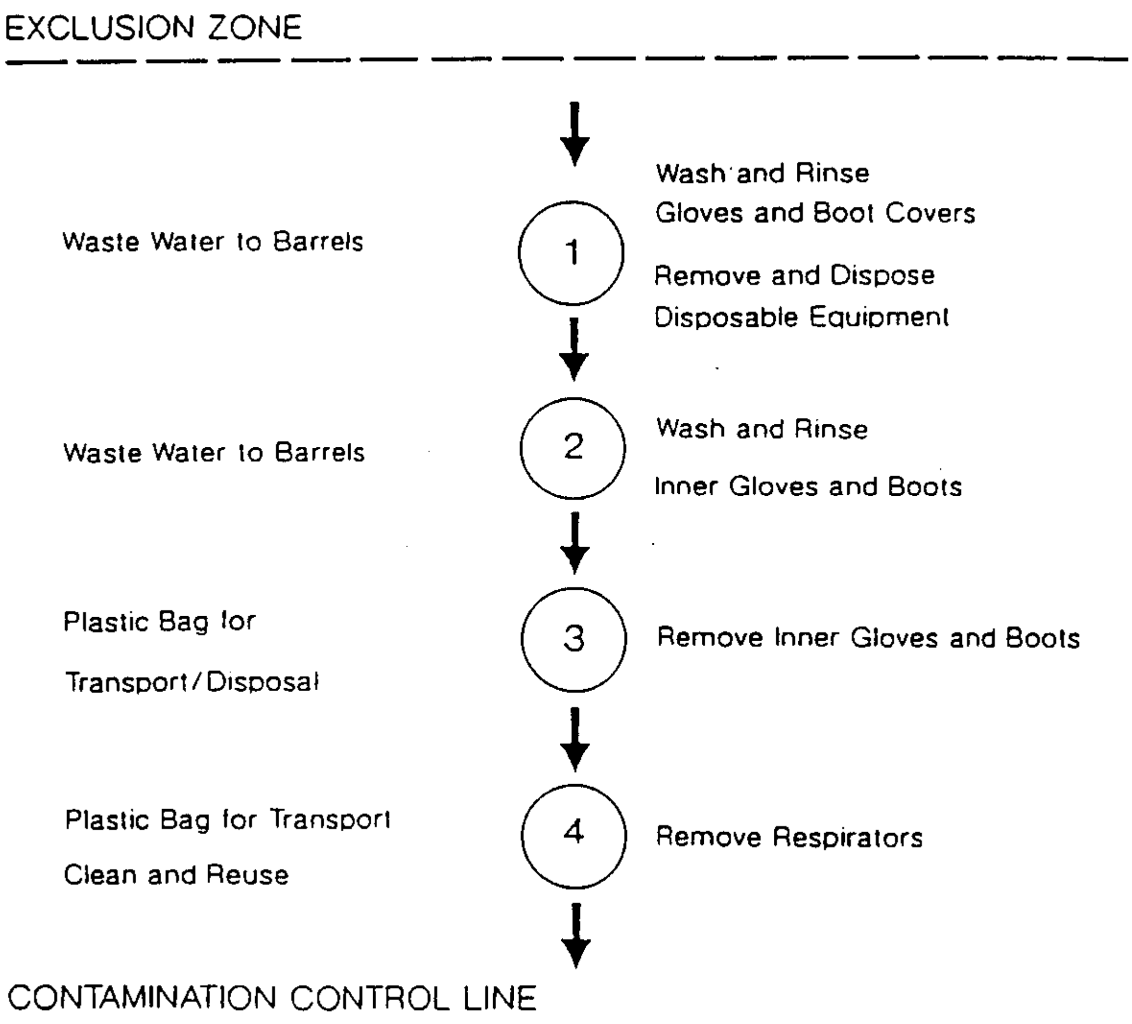

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GERAGHTY & MILLER, INC.
Environmental Services

DECONTAMINATION FLOWCHART

Siemens Nuclear Power Corporation
Richland, Washington

FIGURE
C-3

AIR MONITORING

As noted above, inhalation risks may occur in this project if contaminated soils or water are contacted. In addition, individuals may not always be able to detect ammonia by odor or irritation at levels sufficiently below the permissible exposure limit/time weighted authority since the odor threshold for ammonia varies considerably by individual [from 1 part per billion (ppb) to greater than 10 parts per million (ppm)]. Individuals will also not be able to detect exposures from alpha and beta radiation sources. Because of these factors, air monitoring will be used to determine possible hazardous conditions and to confirm the adequacy of personal protective equipment. Air monitoring will be conducted using Draeger colorimetric ammonia detector tubes (SKC detector tube number 800-33231 or equivalent) and a Geiger-Müller counter equipped with a pancake probe. Field personnel conducting the monitoring with the Geiger-Müller counter will be fully trained in its operation through attendance of Siemens' 5-hour certification course. Monitoring will be conducted periodically during drilling and whenever odor or irritation is noted. Table C-2 lists the actions to be taken

Table C-2. Air Monitoring Action Levels for Ammonia

Monitoring Results*	**Action Required**
< 25% of TLV	• Continue monitoring program
25% to 75% of TLV	• Use appropriate respiratory protection • Confirm adequacy of personal protective equipment • Upgrade if necessary
> 75% of TLV	• Stop work • Contact supervisor
> 50% of IDLH	• Evacuate immediately • Contact supervisor

TLV Threshold limit value
IDLH Immediately hazardous to life and health
* TLV = 25 ppm; IDLH = 500 ppm

based on the monitoring results for ammonia vapors. Air monitoring action levels for radiation will be specified after the Siemens' 5-hour certification course.

Additional air monitoring requirements for drilling near the South Pit will be addressed in an addendum to this HASP.

RESPIRATORY PROTECTION REQUIREMENTS

If monitoring results indicate the need for respiratory protection, a full-face chemical cartridge respirator with a cartridge approved for protection against ammonia vapors will be donned. Appropriate cartridges include the MSA GMD for vapors only or GMD-H for vapors and dusts.

PROTECTIVE EQUIPMENT SUMMARY LIST

- Fire extinguisher: 10 pound ABC CO_2
- First aid kit
- Eye wash kit
- Full-face APR, MSA GMD or GMD-H (or equivalent) cartridge
- Hard hat
- Tyvek coveralls/polycoated Tyvek coveralls
- PVC (or similar) rain suit
- Neoprene steel-toed boots
- Nitrile outer gloves/latex inner gloves
- Disposable dust masks

SITE WORK ZONES/SECURITY

EXCLUSION AREAS

Areas with significant chemical contamination will be considered to comprise exclusion zones. Each person entering an exclusion zone should wear appropriate coveralls, gloves, and neoprene boots or equivalent. The coveralls and gloves will be discarded into plastic bags upon exiting the exclusion zone via the contamination reduction zone. Boots and other equipment will be decontaminated as discussed below with an alkaline detergent wash and water rinse as appropriate. All support functions will be conducted outside the exclusion area(s) in a support zone.

SECURITY

All matters related to site security will be referred to the appropriate SNP personnel.

DECONTAMINATION

EQUIPMENT DECONTAMINATION

All non-disposable equipment will be decontaminated upon leaving the exclusion zone. Portable tools will be placed over drums or other containment devices and scrubbed with detergent solutions and clean-water rinse water and/or sprayed with a high-pressure washer or steam cleaner. Heavy equipment will be positioned and cleaned over similar tubs or water collection systems. Prior to demobilization, all heavy equipment should be thoroughly decontaminated before leaving the plant site.

All disposable equipment, including protective clothing, gloves, and respirator cartridges (where applicable) used during field activities will be discarded into plastic bags by personnel when exiting the work site. These bags will be stored for proper disposal.

PERSONNEL DECONTAMINATION

All personnel with known or suspected contamination will perform a mini-decontamination between separate work tasks or sampling locations and will change respirator cartridges (where used). They will decontaminate fully before eating lunch or leaving the site.

Mini-decontamination consists of the following steps:

- Detergent wash and clean water rinse of boots and outer gloves
- Inspect protective outer suit, if worn, for severe contamination, rips, or tears
- If suit appears contaminated or damaged, decontaminate fully as outlined below will be performed
- Remove outer gloves; discard if damaged or heavily contaminated
- Remove respirator (if worn) and deposit cartridges in labelled drum; refresh inside of respirator with premoistened towelettes
- Replace respirator cartridges and outer gloves and return to the exclusion zone

Full decontamination consists of the following steps:

- Detergent wash and clean-water rinse boots and outer gloves
- Remove outer gloves and protective suit and deposit in labelled drum
- Remove respirator cartridges and discard in drum
- Remove respirator; clean in specially designated respirator wash/rinse bucket
- Remove safety boots and put on street shoes
- Remove inner gloves and discard into drum
- Wash hands and face
- Shower as soon after work shift as possible

The following decontamination equipment will be available:

- Boot and glove wash bucket and rinse budget

- Scrub brushes: long handled with handling hooks
- Spray rinse applicator
- Plastic garbage bags
- 5-gallon container of alkaline decontamination solution

DISPOSAL OF CONTAMINATED MATERIALS

Pump all decontamination solutions and rinse water into labelled drums, which will be stored in a designated site location pending testing and disposition per state dangerous waste regulations. Drums filled with used protective clothing will be labelled and closed. Store drums under plastic sheeting.

MEDICAL SURVEILLANCE REQUIREMENTS

All the members of the field team will have received a medical examination. The basic program consists of a pre-employment (or pre-field effort) baseline physical and an annual examination thereafter. If an employee thinks he/she has been exposed to a hazardous substance while in the field, that person will contact the Office Safety Manager and will seek immediate medical attention.

In general, the initial medical examination is intended to establish an individual's state of health, baseline physiological data, and ability to wear personal protective equipment. The following lists the minimum screening procedures/tests conducted during the medical examination:

- Medical/occupational questionnaire
- Full physical examination by physician
- Vital statistics
- Audiometric test
- Pulmonary function test

- Chest X-ray every three years
- Laboratory blood chemistry and urinalysis
  - Complete blood count with differential
  - Urinalysis with microscopic exam
  - Blood chemistry profile for organ systems evaluation
- Fitness for duty evaluation by occupational physician

This particular program will determine chemical effects to specific target organs and does not try to locate a specific chemical. In the event a specific chemical problem is brought to the attention of the Office Safety Manager, an examination will be given by the occupational physician to determine if there is a problem and the extent of the problem.

SAFETY/ORIENTATION TRAINING

All field personnel for this project will have attended a 40-hour health and safety training course for conducting work at hazardous waste sites and annual 8-hour training updates. This course satisfies the initial training requirements of 29 CFR 1910.120 (OSHA regulation of hazardous waste site activities). In addition to the 40-hour training course and annual 8-hour updates, the Project Manager will have attended an 8-hour Project Manager's Health and Safety Training Course.

Prior to the initiation of site work, all site personnel will be required to attend a training session given by the on-site safety manager. This session will include, but is not limited to, the following topics:

- Site history
- Specific hazards (including toxicological data)
- Hazard recognition
- Standard operation procedures

- Decontamination (personnel and equipment)
- Emergency procedures
- Respirator fit test and use

Tailgate safety meetings will also be conducted whenever field personnel change. The form shown in Figure C-4 should be used during the initial meeting and as applicable during subsequent meetings. Daily tailgate safety meetings will be convened to discuss scheduled tasks and potential associated hazards.

SIGNED:

GERAGHTY & MILLER PROJECT MANAGER

Jay P. Bower — Date

GERAGHTY & MILLER OFFICE SAFETY MANAGER

Anneliese A. Ripley — Date

GERAGHTY & MILLER PROJECT OFFICER

Susan J. Keith — Date

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TAILGATE SAFETY MEETING

Prepared by ____________________

Company ____________________ Location ____________________

Date __________ Time __________ Job Number ____________________

Work Location ____________________

Type of Work ____________________

Chemicals Used ____________________

SAFETY TOPICS PRESENTED

Chemical Hazards ____________________

Physical Hazards ____________________

Protective Clothing/Equipment ____________________

Special Equipment ____________________

Emergency Procedures ____________________

Hospital/Clinic ____________________ Phone (   ) __________

Paramedic Phone (   ) __________

Hospital Address ____________________

Other ____________________

ATTENDEES

NAME PRINTED	SIGNATURE

Meeting Conducted By ____________________ ____________________

Name Printed Signature

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GERAGHTY & MILLER, INC. *Environmental Services*

TAILGATE SAFETY MEETING FORM

Siemens Nuclear Power Corporation
Richland, Washington

FIGURE C-4